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HOW PARKES' TELESCOPE HAS BEEN UPGRADED TO HEAR GALILEO'S CALL...

PROMAX

CABLE TV ANALYSER

The PROMAX-4 is a handheld CABLE TV ANALYSER designed for measurements in TV distribution and Cable TV systems.

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AUSTRALIA with Professional Electronics & ETI

Volume 58, No.4
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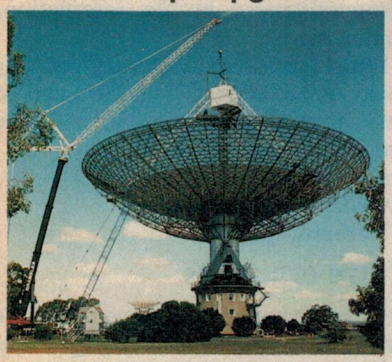
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Parkes 'scope upgrade



Since November last year, CSIRO's 64-metre Parkes radiotelescope has been receiving a major upgrade. Among other things this will allow the telescope to be used to listen for the tiny signals from spacecraft Galileo, as it orbits Jupiter. Geoff McNamara explains, in his story starting on page 16.

Programmable supply

Until recently, programmable power supplies have been too expensive for many applications. HP's new E3631A is an example of the 'new breed' of affordable models. We review it in this issue, starting on page 112.

On the cover

At the recent Consumer Electronics Show in Las Vegas, ITT showed its Night Quest next-generation night viewers, and Sony was one of the firms displaying their impressive new GPS-based mobile route guidance and navigation systems. Louis Challis continues his report on the CES in this issue — see page 10.

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Features

Projects and Technical

Columns and Comments

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Professional Electronics

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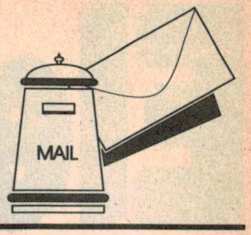
LETTERS TO THE EDITOR



Easyplot to Canon BJ

In the November 1995 issue, NZ reader Kim Welch asked for help in trying to print out PCB board patterns from Easytrax on his Canon BJ-10sx printer.

This is actually quite easy to do, and you don't need to worry about DOS Postscript drivers. In fact, the reader has said enough in his letter to suggest that he already has everything he needs to do the job. I'll explain:

When in Easytrax, he needs to plot the file as a single-pen HPGL file — there is a selection which allows you to plot to a file in EASYPLOT, the printing half of Easytrax. The only thing you need to make sure of is that you have the correct layer selected and that the scale is set to 1.414.

The next task is to open up MS Publisher in Windows (which the reader mentions in his letter he already has, and uses to great effect with his printer).

He then creates a new document and imports the HPGL file into the document. All good desktop publishers (Pagemaker, Quark etc) allow you to import files from different formats and HPGL is a common one. The scale information is important because the file should now automatically print at normal size.

Next, he simply prints the document in Windows to his printer and everything should work out well.

Darren Yates,
Frenchs Forest, NSW.

Griffith Uni

I was pleased to find so much information in the November issue of *Electronics Australia* regarding the Industrial Affiliates Program and the Professional Development Courses that Griffith University's School of Microelectronic Engineering runs.

The School of Microelectronic Engineering at Griffith University is dedicated to not only graduating superior Microelectronic Engineering students, but also to acting as an industry resource.

Australia's international success is predicated on closer cooperation between academia and industry. The more interaction tertiary education has with industry, the better prepared students are, and the more industry accesses the resources represented in tertiary programs, the better will be industry's competitiveness in the international market place.

I trust our association with your magazine will continue. Thanks again for your support of the Industrial Affiliates Program.

Carol-Joy Patrick,
Griffith University,
Natham, Qld.

Valve era parts

I have accumulated a large quantity of valve era components, including: valves; RCA oscilloscope; Resistors - carbon and wire wound; Capacitors - can, paper, mica; potentiometers - switches; transponders and chokes; miniature valve radio x USA; amplifier speaker microphone (portable Ediswan); loudspeakers; magazines - *R&H* and *EA* starting 1945

I have no further use for this material and would be pleased to give all to an interested hobbyist rather than take it to the tip.

I would be grateful if you find space in *EA* to advise your many readers who may be interested.

My phone number is (02) 9948 3156.

Alan Whitfield,
Balgowlah, NSW.

E-M fields & cancer

The article by Tom Moffat on 'Cancer and E-M Fields' (Feb 96) was interesting, but isn't quite right in its description of how cancer originates. He indicates that slight damage to the genetic material (DNA) in cells can be passed from one generation to the next as mutations — if reproductive cells are the ones damaged.

That's fine. He then says that the multiplication of such mutated cells generally results in cancer. Intended or not, the implication is that reproductive cells must initially be involved in cancer.

Not so! If this was the only way, then cancer would not appear until the next generation. This is obviously not what happens. If a mutation is introduced into the DNA in any cell in your body by

radiation (or some other means such as chemical agents), then it has the potential to develop into a cancer cell right there and then. It can be a liver cell, a skin cell or a brain cell for that matter.

The mutation in such cells will only produce cancer, however, if the mutation is in certain genes or areas of the DNA. There is evidence, for example, that cancer may result from mutation of parts of the DNA that code for proteins controlling cell growth. Once these parts of the DNA code are knocked out by mutation, multiplication of that cell starts occurring at a rapid rate. A cancer or tumour, after all, is just a mass of cells proliferating and dividing at an uncontrolled pace.

Reproductive cells can equally become cancerous through mutation — hence cancer of the testes or ovaries.

Alternatively, mutations in reproductive cells may not lead to cancer, but can be carried on to the next generation as some other form of damage or defect, but only if that reproductive cell happens to be the one that produces a fertilised egg.

One sperm and one egg unite to produce a fertilised egg — which itself is a single cell. Every cell in your body is derived from multiplication of that one fertilised egg cell.

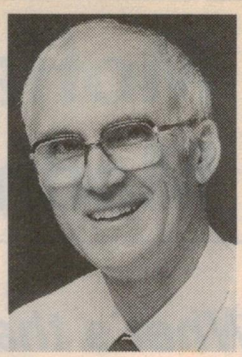
The implications of mutations in reproductive cells are very worrying. Since every cell in an individual is derived from that single fertilised egg cell, if the latter contains a mutation, then every cell in the individual produced from that will contain the mutation. This is the basis of genetic 'diseases' passed from one generation to the next.

That's all I have on cancer, but just another minor comment on Tom's other contribution (Moffat's Madhouse), and also the article on Comdex by Mark Harris. Both of them used imperial measures (feet, yards etc) in their articles. Can you please edit these out and replace them with metric? Australia did go metric a long time ago, and in any event, it is a much better system especially for a technical journal such as *EA!*

Glenn Pure, PhD
Kambah, ACT.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



A glimpse of the future

A couple of weeks ago, I was able to attend what turned out to be one of the most interesting and thought-provoking press conferences I can remember. It was held by Intel Australia at its Sydney premises, and the occasion was the dedication of their new Broadband Test Centre (see our news columns, page 106).

One of the first projects for the new Centre is to organise field trials of Intel's cable modem technology, in various countries throughout the Pacific Rim — including Australia. And because of the interest in this exciting new technology, the company took the opportunity to give us an update on its current status.

Centre Manager Teri Lasley told us of the success of recent trials she coordinated for Intel in the Castro Valley community in California, in conjunction with Viacom Cable and Hybrid Networks Inc. Over two-thirds of the private cable TV subscribers who participated in the trial were so impressed with the high speed Internet access and other interactive services they'd experienced, that when the trial ended they cheerfully signed up to pay fees. In fact the typical response was "Don't even *think* of taking my cable modem away!"

After seeing a brief demonstration of the kind of performance delivered even by Intel's first generation of CablePort modems, I'm not at all surprised. Being able to download data at 10Mb/s is so much faster than either 28.8kb/s modems, or even Basic Rate ISDN, that there's really no contest — and we learned that by about the end of this year, the new 'interoperable' versions will be nearly three times faster again!

Frankly, from what I saw, I have no doubt that for most of us, cable modems are likely to represent the future of broadband data communications. And an exciting future it is, too, with the potential to provide us with a huge range of interactive services at about the same cost as current 28.8kb/s modems.

So even if you're like me, and not wildly enthusiastic about Pay TV itself, there's still going to be a powerful reason to become a cable network subscriber...

Actually the Intel press conference also provided a more direct glimpse of this same future, albeit via a 128kb/s Basic Rate ISDN link. Through the link we were joined by Avram Miller, a corporate VP of Intel, and also Doug Semon, a VP of Viacom Cable — both sitting in Mr Miller's office in Santa Clara, California. The link provided full duplex audio and video, and after they had given us a presentation we were able to ask them questions.

The video quality was only modest, as you'd expect from a 128kb/s duplex circuit; after all, the degree of compression involved is enormous. But it was quite satisfactory for this sort of purpose — and the important point is that it was using what is essentially *current* PC and ISDN technology!

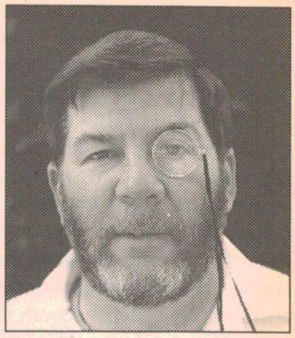
Thanks to the current rollout of cable TV networks by Optus and Telstra, at least *some* Australians are likely to be able to take advantage of cable modems by the end of this year (i.e., at virtually the same time as most people in the USA or Europe).

It's a very exciting prospect, don't you think?

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



What's that NOISE?

Irritating, isn't it — you want to listen to something on the radio and all you get is BZZZZ. Or crack-crackle, or various pings and snaps and whines. RFI it is, good ol' Radio Frequency Interference. And in today's modern world, there's plenty of it...

Just imagine what it would have been like 50 or 60 years ago, as a radio ham or shortwave listener. Then you could turn on your receiver and hear weak transmissions from the other side of the world, unimpeded by anything other than natural 'static'. Man-made noise was just about non-existent then.

But now, nearly everything that has electricity going into it has electrical noise coming out of it. Some of it is simple power-line noise, caused by something like a sparking commutator in a motor (try on an old food mixer, for starters...). The real offenders, however, are modern gadgets containing microprocessors.

I have mentioned before that my home in Hobart is at the outflow of an RF sewer, and most of the sludge comes from the top of nearby Mount Wellington. That site is plastered with TV transmitters, FM transmitters, two-way radio transmitters, paging transmitters, all going at it at once. They radiate in grand style on their own frequencies, but they work together to do a pretty good job on other frequencies as well.

When I was busy developing weather satellite receiving equipment, I could never receive signals on the prime 137.62MHz satellite frequency. All I got was a mixture of two commercial FM stations, radiating signals many times stronger than the tiny five-watt signal from the satellites, which were at least 600km and more likely 3000km distant.

I mentioned this problem to the good people at the SMA (Spectrum Management Agency), and they turned up at my place armed with directional antennas and spectrum analyzers. It didn't take long to track down the source to Mt Wellington — but not to the transmitters themselves. The stray signal was coming from the metal tower carrying many of the antennas.

The tower was old, and somewhat beat up, and many of the bolts holding it together had developed oxides (rust) under them. The bolts formed mixing diodes, and under the influence of transmitters of several thousand watts the bolts were radiating mixing products many times stronger than the desired signals on 137.62MHz (and lots of other places as well).

That tower is being replaced by a new concrete structure, which may be in use by the time you read this. So hopefully it's goodbye to noise from Mt Wellington.

But that's only part of the problem. A worse noise source is right on my desk. Actually there are several sources. I cannot use my portable telephone when the fax machine is running. I can't use my VHF receiver when the computer is running. The computer also messes up the portable telephone. The power supply for my laptop computer wrecks my portable shortwave radio. And if you plug an external power supply into my little palmtop computer it noises up everything — radiating back out through the power connector.

My answering machine doesn't generate much noise, but it *receives* it very efficiently via the telephone line it connects to. Any time the answering machine's volume is turned up to a reasonable level, the speaker spews out television frame buzz, picked up from one of the Mt Wellington transmitters. What a mess!

Most of the above-mentioned devices, even the telephone and the answering machine, contain microprocessors. The laptop computer's power pack contains a switch-mode power supply. The desktop computer contains a switch-mode power supply as well as a microprocessor, and the computer's monitor has all sorts of horizontal and vertical scanning circuitry. Everything radiates!

As yet in Australia there isn't a lot you can do to stop noisy electronic equipment; you just have to grin and bear it. But in my temporary home here in the USA, the FCC (Federal Communications Commission) has long had laws regulating noise levels emanating from electronic gear. Under the heading of 'Part 15' the regulations are split into two categories — domestic equipment (Class B) and commercial equipment (Class A). Class B is the more stringent.

The regs apply to products containing computer equipment, and computer equipment is defined as anything operating at a frequency of 10kHz or above, using digital techniques. In today's world that means just about everything, even your car or your washing machine.

It is interesting to note that the regulations do not apply to switch-mode power supplies, except when the supply is part of some product also containing computer equipment. In fact most things operating at powerline frequencies seem to be ignored.

For many years it has been common for electronic items, such as computers, to be 'dumped' in Australia if they didn't meet the US noise standards. This has been bad from a noise point of view, but probably good from the standpoint of being able to buy cheap computers.

Computers sold on both the US and Australian markets must meet the US emission standards, and you can certainly see an improvement compared to the non-USA-approved products. Most laptop and notebook computers, for instance, are marketed worldwide and thus are pretty quiet RF-wise. The computers Commodore used to make, such as the Commodore 64 and the Amiga, contained elaborate shielding and thus became the darlings of radio

amateurs who wanted to use them for radio-related applications such as packet and radioteletype.

It's interesting to speculate what will happen once the authorities have tightened the regs, as is now starting to happen, so electronic equipment sold in Australia will have to meet stringent noise emission standards. We will probably see some of the truly el-cheapo computers withdrawn from the market, rather than being redesigned to meet the standards. But will this be such a bad thing? Some of them are pretty horrid, and many people have been bitten by duds — maybe we're better off without them.

Here in the USA you don't seem to see any of those nasty no-name computer clones, yet prices are still reasonable. There just aren't as many choices; when you go into K-mart or any of the discount houses, it seems nearly everything has Packard-Bell written on it.

Interesting exercise

As mentioned above, the USA regulations seem to ignore equipment emitting energy at powerline frequencies, but not sharing a box with 'computer equipment'. One night I got the itch to do some snooping around on the AM broadcast band to see if I could pull in some distant stations. But the whole lower half of the band was zapped by a horrible powerline buzz.

Rather than accept it, I decided to do something about it, which led to an interesting exercise of the type radio amateurs call a 'foxhunt'. Maybe a description will help you track down something that's been bugging your radio.

My little AM radio is one of those Sony portables that covers the LF, MF, HF, and VHF spectrum. I began chasing the noise source by tuning the radio to a frequency where the noise was loudest. This turned out to be 300kHz. The radio's ferrite loopstick antenna is very directional at these frequencies; in fact the LF frequency range is used almost exclusively for radio direction finding.

I rotated the radio around and managed to find a null in the noise, which indicated vaguely which direction it was coming from. The null applied in both directions, so my first bearing could have been 180° out. I took the radio outside the house and the null sharpened dramatically — it had probably been influenced by the house's electrical wiring and plumbing.

My home here in the USA is in an inner-city area. Within 100 metres of the house is a telephone exchange, a fire station, a public library, and a dentist's surgery. The telephone exchange was a good suspect for the noise, since those places derive almost all their operating power via switch-mode power supplies. They're used to charge batteries, which in turn power the telephone equipment.

The fire station is at one of the highest points in town, and it sports a couple of towers containing two-way radio equipment for many services, including the local amateur two-metre repeater. There are several computers in the fire station, as well as various battery charging equipment. The public library is full of computers; a big one containing an electronic version of the library's card catalog, as well as some terminals and a couple of Macintoshes used for public Internet access. As for the dentists' surgery, again there are computers and — do dentist drills use switch-mode supplies?

Out in the road, the radio's null pointed firmly at the telephone exchange. I walked toward it, but as I became closer the directional null seemed to veer away. So I crossed the road to the fire station, and as I approached the noise got weaker and the null veered again. When I moved toward the library, the noise stayed pretty much the same and the null seemed to point back to the fire station.

Next I tried the dentist's surgery. The signal got stronger, but the directional null became totally confused. As I walked along, the null would swing left and then right, and finally there didn't seem to be any null at all. What gives?

I dropped the radio down to my side while I stood there trying to figure out where I had gone wrong. And then, there was a quick drop in the signal. The antenna was no longer level — could the noise source be UP? I did some further exploration, tilting the radio up and down as well as swinging it round and round. And there it was — a sodium-vapour street light!

I backed away a little and then sighted along the top of the radio while swinging it right, left, up, down. There was a good deep null, pointing right at that street light. I walked around the light about 90° from the original position and tried the right-left-up-down trick again. Spot on; the line of sight along the top of the radio pointed right at the street light when the null was deepest. Gotcha!

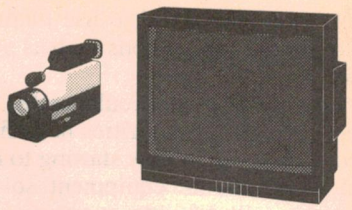
So now I knew where the noise was coming from — but what was I going to do about it? Good question.

The offending street light is not owned by the council; theirs are all nice and quiet. This one appears to have been privately installed, to illuminate the dentists' surgery carpark and keep the baddies away at night. Since there is no standard for noisy street lights, I can't squawk to the FCC. I could pelt it with a rock I suppose, but that could draw an unwanted visit from the police.

There is one chance however. It seems that the light turns itself on and off automatically at dusk and dawn. It's probably a simple photoelectric device, but could it be that a modern street light contains a microprocessor to make its control 'smarter'? If so, maybe we could nail it under FCC Part 15. Looks like some further research is required...

So next time you go out with a portable radio trying to track down a noise source, remember to swing it up and down as well as round and round. Hold it up; sight along the top. This will certainly pin down noise sources from above, and it will provide interesting entertainment for other people who might be sharing the street with you. Hey, look at that guy! He's rap dancin! ❖

What's New in VIDEO and AUDIO



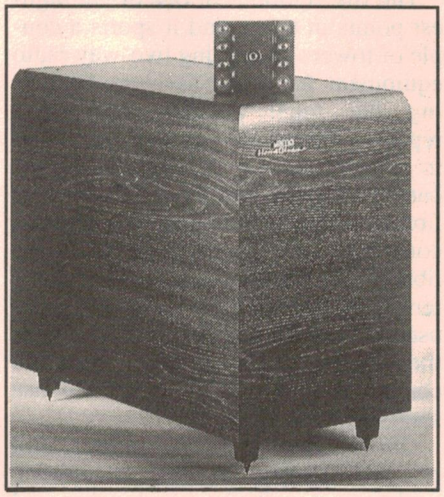
Jamo releases new subwoofers

Leading European speaker manufacturer Jamo has introduced two new powered subwoofers. The new models are the SW-400e at $999 RRP and the SW-505e at $1299, complementing the already established SW-600e at $1699.

Many movie soundtracks feature very deep bass that must be felt rather than heard. Each of the JAMO subwoofers is designed to reproduce the floor-shaking realism of an explosion or a helicopter flying overhead.

With typical Danish styling, the subwoofers have elegant smooth lines and attractive Black Ash finish designed to enhance any living room.

But the most interesting feature of the two new models is an innovative 'Connection Box', designed to simplify system connections where the main amplifier has no subwoofer output. With the SW-400e and 505e, the Connection Box sits immediately behind the amplifier; only a few centimetres of cable is required between the amplifier and the box, and then only the normal length of speaker cables running on to the main speakers. A single lead then links the Box to the subwoofer.



The SW-400e features a 203mm (8") long-throw woofer driven by a 90 watt built-in amplifier, while the SW-505e has a 305mm (12") long-throw woofer with a 100W amp.

Adjustments include Level (or volume), Crossover Frequency (between 70 & 150Hz) and the special feature of Variable Phase (adjustable continuously between 0 - 180°), allowing placement almost anywhere in the listening room. This is an especially user friendly facility as the subwoofer adjusts to suit your room rather than re-arranging your room to accommodate the subwoofer.

The Jamo subwoofers are supported by a two-year warranty and are available from selected hifi dealers round Australia.

For further information circle 271 on the reader service card or contact Scan Audio, phone (03) 9429 2199 or fax (03) 9429 9309.

New R-DAT recorder from Otari

The new Otari DTR-8 R-DAT Digital Audio Tape Recorder follows on from the earlier DTR-7, but boasts enhanced capabilities for professional recording and mastering applications.

Expected to gain wide industry acceptance in sophisticated audio/video systems and installations. Audio inputs include Phono, CD, Tuner, Tape 1 and 2; A/V inputs include LD/TV, VCR 1 and 2, and a front panel Auxiliary input.

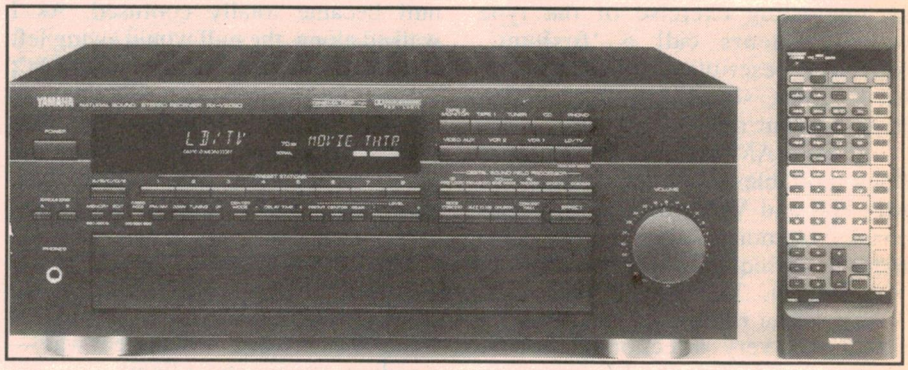
Other features of the RX-V2090 include bass and treble controls, tone control bypass, balance, independent record output selector, bass extension, -10dB main level attenuator which is useful if very efficient front speakers are connected), and motor driven remote controllable volume control with LED.

Seven channel A-V receiver

Yamaha's seven channel A/V receiver, the RX-V2090, provides a variety of 'Digital Sound Field' programmes designed for music as well as digitally processed Dolby Pro Logic and Yamaha's 70mm Cinema DSP, which gives impact to movie sound.

In addition, this new receiver is Dolby Surround Digital (AC-3) ready. In conjunction with Yamaha's new separate AC-3 processor, the DDP-1, the RX-V2090 provides the most dramatic and realistic movie sound regardless of whether the source is mono, Dolby Pro Logic, or Dolby's new AC-3 digital surround format. The RX-V2090 is claimed to incorporate the most sophisticated processor ever built into an A/V receiver.

Using the company's proprietary technology, Digital Sound Field Processing (DSP), the receiver's 10 different sound programmes include the acoustic blueprints of several sampled music venues, as well as computer models of 'acoustically ideal' generic environments, plus Dolby Pro Logic.



The RX-V2090's amplifier delivers 100 watts across the three front channels and 35 watts to each of the four effects channels.

In addition, should more power be demanded, rear panel pre-out terminals allow for the connection of separate amplifiers for all seven channels, plus a subwoofer.

With four audio/video inputs — one with an S-video terminal — five audio only inputs, and a discrete five channel input for AC-3, the RX-V2090 can serve as the command centre for even the most

CD player offers 20-bit performance

Kenwood has announced its DP5060 CD player, with DRIVE or Dynamic Resolution Intensive Vector Enhancement technology — claimed to produce clarity and detail approximating 20-bit resolution.

Kenwood says that DRIVE technology works by adjusting the digital filter cut-off frequency/frequencies in proportion to the degree of data repetition. The filtered output is then sent to a 20-bit DAC, where a variable delay compensates for filter computation time. The end result is high resolution throughout the audio spectrum, particularly noticeable during softer musical passages.

Other innovative technologies include a zero shift, one bit DAC with fourth order noise shaping and a High Precision Master Clock that 'synchronises' all sampling units to unprecedented accuracy. A class AB pick-up actuator amp coupled to an optimum linear cascade DRIVE circuit culminates in lower distortion and greater sound resolution, particularly at lower sound levels.

The DP-5060 is covered by a 24 month parts and labour warranty (12 months on laser pick-up), has an RRP of $599 and is available at selected Kenwood dealers.

tance, the first DTR-8 recorder in Australia has been acquired by Sydney based Black Inc Recorders.

Otari says the new DTR-8 was designed for professional applications. Housed in a rugged rack mounting enclosure, it features a 2-head mechanism, pulse flow 1-bit D/A converters, 1-bit wide range linear A/D converters, +4dBu/-10dBV switchable active balanced analog I/O on XLR type connectors, AES/EBU and S/P-DIF digital interfaces, high speed search at up to 300 times play speed, no Serial Copy Management System, and an hour meter to monitor usage and assist with scheduling regular maintenance.

The DTR-8 is supplied with a wireless remote control and accepts remote control signals via a parallel control port.

For further information circle 290 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211.

Pro-Logic midi surround sound system

Kenwood has introduced the M-49MCRS Dolby Pro-Logic Surround Midi system, a complete home theatre system in a compact and affordable form.

To create 'life size' sound effects, the M-49MCRS has a 3-way, 3-speaker system comprising 200mm woofer, 65mm mid range and 50mm tweeter, with detachable grille, and front centre speaker plus rear surround sound speakers. The system provides 75 watts to both front left and right speakers, 20W to the centre and 5W to each of the rear surround speakers.

A major feature of the M-49MCRS Midi is the full Dolby Pro-Logic surround sound, which when combined with three presence modes (Arena, Jazz Club, or Stadium), further enhances the home theatre concept by creating the 'ambience' with spatial and reverberant effects normally only found in modern theatres.

The system also features Dolby 3-stereo for those times when front surround is all that is required.

The AM/FM synthesised stereo tuner section offers up to 40 presets to store favourite AM and FM stations and a built-in Programmable Timer allows you to wake-up to CD player, tape or your favourite radio station. A five disc CD player incorporates the latest single-bit technology.

The M-49MCRS (RRP $1649) is covered by a two year warranty and is avail-

Video projectors feature line doubler

Extensive research based on Barco's world wide experience in large screen projection has resulted in a new high performance digital Line Doubler which can be built into Barco's 700 series video projectors and RCVDS 05 switchers. Barco's line doubler kit consists of a video decoder with three line adaptive comb filter, enhancement circuit and the line doubler itself. The three line adaptive comb filter improves colour transitions and reduces noise in the video signal.

The enhancement circuit integrated in the decoder provides sharper images with clearer outlines. The line doubler itself eliminates the video line pattern by doubling the number of lines of the video image. All this guarantees the projection of a more stable, smoother and sharper video image with flicker free pictures.

Barco says that when combined with the high light output, wide source compatibility, unequalled picture sharpness and unmatched user friendliness of its video projectors, the line doubler provides an ideal solution for home theatres, video theatres and video conferencing facilities.

For further information circle 289 on the reader service coupon or contact Trace Pacific, 8 Prohasky Street, Port Melbourne 3207; phone (03) 9646 5833. ❖

THE 1996 WINTER ELECTRONICS SHOW - 2

Here's the second part of Louis Challis' report on the 1996 Winter Consumer Electronics Show (CES), held in Las Vegas. As he explains, there really were a lot of exciting new products on display — quite apart from the Digital Video Disc developments he covered last month.

Last month I described the principles and advantages of Digital Video Discs (DVD), which I perceive as being the most important consumer electronic development in 1996. At this moment, most major Japanese manufacturers, Philips in Endhoven and an assorted collection of Korean manufacturers are gearing up to release their DVD players on the world market.

But as important as DVD appeared to be, there were a plethora of other developments and releases at the CES, which were just as important.

Before I had even walked into my first exhibit at the CES, my eye caught sight of a blue sheet of A4 paper with a heading 'CES Exhibitor's Noise Ordinance Policy' in light gothic printing at the top. As always, I am interested in such issues, so I picked up the paper to read its contents.

As I read further, I discovered that after many years of blasted ear drums and disturbing cacophonies of sound, the CES have finally put their foot down, and imposed a 95dB(A) limit on each exhibit.

As I read further, I discovered that where exhibitors demonstrate audio equipment in an open display area, they must use either a sound chamber or appropriate sized barriers to limit the intrusion into adjacent exhibits.

Where the audio equipment is demonstrated within a vehicle, its windows and doors must be closed. Where exhibitors fail to impose self-regulation, the CES will give a first warning following a complaint being registered by either a spectator, neighbouring exhibitor, or the official whose duty it is to monitor the sound levels in that area.

Exhibitors were given a first warning and a second warning. After the second warning, any further infringement would lead to the disconnection of the exhibitor's power source for the remainder of the show. Worse than that, the violator would receive no refund of its exhibit fees. The CES obviously meant business, and as far as I understand, *nobody* transgressed more than twice...

A group of the new B&W 'Minipod' loudspeakers, which are remarkable not only for their appearance but also the performance they give for a relatively low price.

As strange as it may sound, the first display that I entered on my first morning at the show was the Osborn loudspeaker display. I met Greg Osborn, the speaker's designer, and was more than a trifle chuffed to find that Osborn were displaying what they described as their latest 'No Compromise Loudspeakers'.

Greg was very proud of their top-of-the-line Epitome speakers, each of which weighs 65kg (which also happens to be my weight). Frankly, the Epitomes look better and with their genuine 25Hz to 19kHz bandwidth, even sound better. I didn't ask their price, as only US prices were being quoted at the CES.

There were a host of new and esoteric loudspeakers on display. The loudspeaker system that made the most significant impression on *me* was the 'Genesis 2000'. At a cool US$33,000 a pair, one would expect a dazzling performance — and frankly, I wasn't disappointed.

A well respected American reviewer had already seated himself in the 'sweet spot', ready to conduct his own assessment. I seated myself next to him, and was delighted to find that he had organised his own special demonstration involving a series of A-B tests with selected software. The system which was being evaluated offered the choice of CD player or LP disc, a pair of Krell amplifiers and expensive Cardas Hexlink cables (with a selling price in the order of US$300/metre).

The American reviewer had already handed over his demonstration CDs and records, and I was delighted to sit in and listen. What ensued was one of the most exciting and memorable audio experiences that I can recall.

The goal of every speaker manufacturer is to provide sound which is indistinguishable from that which would have been heard had the recording microphone(s) been replaced by your head. Well, this was the closest I have ever been to recreating that situation, or at least I believe it was. With my eyes closed, I felt I only needed to stretch my arms out to be able to touch the musicians.

As an innovative approach to the current emphasis on home theatre with subsonic 'bells and whistles', Aura Systems were demonstrating the Interactor Cushion — which vibrates your body with the low frequencies, rather than generate them as sound waves.

Uncanny experience

Whilst the experience was uncanny, it was equally rewarding. Obviously, I would be keen to comprehensively review a pair of 'Genesis 2000' if they ever came to Australia. However at US$33,000 a pair, the Australian price is likely to exceed $60,000 a pair, and at that price there would be relatively few potential buyers.

Following my introduction to the 'Genesis 2000', I went to another demonstration suite, where I auditioned the 'Wilson Audio Specialties WITT Loudspeaker'. This is a three-way loaded loudspeaker system, with an US$8888 price tag and a modular weight of 83kg each. The WITT loudspeakers also offer an outstanding performance, and although I couldn't conduct a comparative test, the quality of their sound was not unlike the B&W 801M Series II loudspeakers. The B&W 801 series are now used by more than 80% of the major classical recording studios in the world.

There were other exciting speakers on display. One that took me by surprise was the Oskar 'AVT' (Air Velocity Transformer) speakers. These incorporate the exciting Heil mid/high frequency drivers with a conventional vented speaker enclosure for the bass.

Twenty years ago I purchased a set of ESS speakers, which were the first commercial speakers to use the Heil high frequency driver. They worked remarkably well, and their dipole sound radiation characteristics achieved good results, particularly when correctly placed in a room with a reflective rear wall. The Oskar AVT speakers are manufactured in Switzerland, so it seems unlikely that they will find their way on to the Australian market.

I visited the KEF stand, and was surprised that there was an entirely new line-up of loudspeakers. I looked for, but did not find any of the 'tried and true' systems incorporating the advanced technological developments pioneered by Laurie Fincham.

I inquired what had happened to the KEF Series 104 and 105s, which I and most other serious reviewers had respected. I was surprised to discover that, with the exception of their Uni-Q coaxial tweeters (which were one of Dick Small's major contributions whilst working with the firm), KEF are now manufacturing a radically new line of speakers.

KEF were singing the praises of their new 'KEF Quality 6 Speaker Home Theatre System' including their 30B powered subwoofer, the model 60S satellite/surround speakers and model 80C centre speaker. With a selling price of under US$1600, the price looked attractive — but the performance wasn't really in the same class as the KEF 104 and 105 Series speakers.

I moved on to the B&W stand, where there were a host of new innovative speakers. B&W have also developed special sets of speakers for Dolby AC3, as well as for the Lucas THX system. The company have made tremendous advances with their Solid range of speakers, which I must admit sound somewhat better than they look.

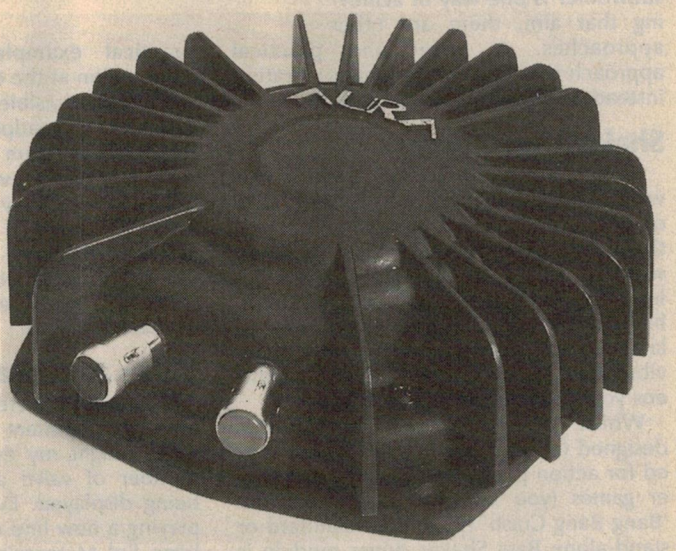
However, when it comes to developing strange looking speakers, B&W have never been slouches. Their award winning 'Blue Room Minipod' would look more at home in a science fiction video than they would in most residential situations (see photo). However these 'cute' little GRP (glass reinforced plastic) moulded speakers, finished in either red, white or blue, are as innovative as they are attractive — although the latter may well be subject to debate.

The Minipods offer a broad frequency response, which covers the frequency range of 70Hz to 30kHz. B&W claim that they achieve a +/-2dB performance over a 60° horizontal arc and a 30° vertical arc, which is a remarkable performance claim for such relatively inexpensive speakers. The secret of their success may be traced to the use of glass reinforced plastic, which facilitates mass production, and allows them to market the speakers at US$800 a pair.

As I slowly progressed through dozens of 'high-end' product displays at the Sahara Hotel, I discovered that almost every single manufacturer was marketing a centre channel or low frequency effects channel speaker system.

The vast majority of these were self-powered subwoofers. All the manufacturers had apparently had their 'ears to the ground', and all of those sub-woofers were designed to meet Dolby AC3 requirements.

Now Dolby AC3 provides a 3Hz to 120Hz sub-woofer channel output. Whilst I doubt that any of the subwoofers provide a useable output at 3Hz, some of them certainly provide useable out-



And for those who want to be shaken more strenuously at low frequencies, Aura can provide the Pro Bass Shaker — which screws onto a wall or floor...

put at 15Hz. Most of the subwoofers I saw provided a good output down to 20Hz or 25Hz.

I had innumerable opportunities to audition Dolby AC3 systems. There were at least 20 separate demonstration systems in various suites at the Sahara Hotel, and many more at the main convention centre. Whilst at least three displays were using pre-release DVD discs and players, the rest used conventional Pioneer AC3 compatible laserdisc players.

Each AC3 demonstration was impressive, and I formed the view that the visual aspects of such demonstrations modify our aural impressions. Not so surprisingly, there have been a number of papers presented on this at recent AES conventions. Whilst the most popular laserdisc video being displayed was *True Lies*, I observed at least two other titles — all of which made appropriate and frequent use of the subwoofer's potential. The peak low frequency sound levels exceeded 120dB, and infrequently appeared to be in excess of 130dB, especially for explosions.

I came to the conclusion that the miserly '0.1 channel' subwoofer bandwidth is far more important to the AC3 system than might otherwise have been imagined...

Most of the new conventional video software and many of the computer games which are now being released, place significant emphasis on being able to tickle your ears and your imagination with subsonic or infrasonic sound energy. Whilst a conventional subwoofer is one way of achieving that aim, there are other approaches. A novel and practical approach is to use low frequency vibration instead of low frequency sound.

Shaking your body...

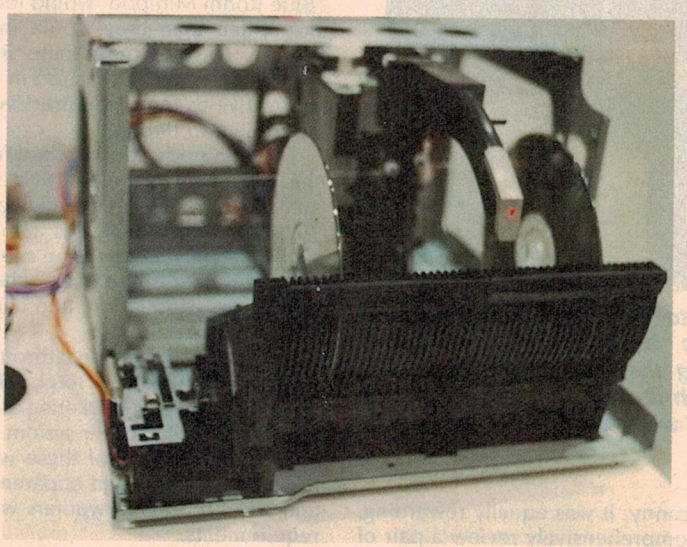
AURA systems have taken their unconventional Bass Shakers (which are a form of board shaker) and have incorporated them into a novel seat back cushion, which is called the 'Interactor Cushion'. Instead of generating low frequency (audible) sounds, the Interactor Cushion translates the sound energy into body-pulsing vibrations. AURA claims that this 'heightens your audiovisual experience'.

Whilst the Interactor Cushion was designed for, and appears to be best suited for action packed multimedia computer games (you know what I mean, the 'Bang Bang Crash' type), their standard or stand-alone Bass Shaker driver module is designed for installation behind, or under theatre or car seats. In the higher rated 50 watt input version, they may also be placed under dance floors, or even behind interior walls inside your house. The only caution required with a wall mounted system is to ensure that the subject wall is not a common wall which you share with your neighbours!

Aura provided me with a Pro-Bass Shaker for evaluation. I evaluated the unit on my return, and after using four wood screws confirmed that the Bass Shaker is extremely easy to install. It provides a useable 20Hz to 80Hz bandwidth, with most of the energy being at the body shaking frequency of 40Hz.

You feel the vibration, rather than hear the sound, but the physiological effect is basically the same.

Following my visit to Japan two years ago, I really expected to see some new practical examples of Active Sound Attenuation at the CES. The examples that were readily visible were the Active Noise Attenuating headphones from Koss, the headphones from NCT, and two new models which have been developed by Sony. Whilst Sony were displaying their large MDR-NC10 and their miniature MDR-NC20s, they only intend to import the MDR-NC20 to Australia. The Sony MDR-NC20s will sell for $299, and will be available in April.



Sony displayed this unusual CD changer (shown here without its case), which stores 100 CDs and is reminiscent of a jukebox.

Valve amplifiers

Whilst there were a plethora of new and exciting amplifiers on show at the CES, what caught my eye was the prodigious number of *valve* amplifiers which were being displayed. Even Marantz were displaying a new line of what had previously been Sol Marantz's most popular (earlier generation) valve amplifier.

Marantz were not alone, and I counted at least 15 different brands of valve amplifiers, including the popular monoblock variety. Although you, like I, may have thought that valves and valve amplifiers were already *passe*, there are apparently many people who think otherwise. Those people are generally convinced that valve amplifiers can outperform almost any transistor amplifier.

Now as it happens, the very best of the valve amplifiers *were* exceptionally good, quite apart from being relatively expensive. The best of the new valve amplifiers are undoubtedly good — but not to my mind, sufficiently good (or better), to warrant a US$89,000 price tag!

This is in fact the tag on the Ongaku integrated amplifier, which has a 211A triode, single-ended 27 watt output per channel capability and takes some beating. The hand-wound transformers use silver wire, and all the capacitors use silver foil in lieu of the more conventional aluminium foil. The price is esoteric, and yet there are apparently people out there who are prepared to pay it!

Other more conventional valve amplifiers on display ranged in price from US$3000 to $10,000. I however formed the view that whilst those amplifiers have a different (and unquestionably more mellow) sound when compared with the transistor amplifiers with which I have become reconciled, I for one simply cannot justify that sort of money for only a 7-27 watts of power output.

Even more surprisingly, the American hifi shops are now selling reasonably large numbers of valve amplifiers. What was all the more surprising to me was that there are people who are prepared to spend US$5250 for a pair of valve amplifiers with a Chinese 300B output valve, providing only 7W peak output.

The bigger amplifiers apparently cost more, but I simply cannot see where the value is. Some of the less expensive variants of those valve amplifiers are already available in Australia, and I have no doubt that somebody will decide that a $10,000 price tag is warranted for an outstanding valve amplifier.

'Enhanced' cables

Of course one can't talk about valve amplifiers (or any other sort of amplifier) and speakers in the one breath, without talking about speaker cabling. Most of us are aware of Monster Cables, Van der Hull's cables, and other notable exponents of enhanced quality speaker cables. I acknowledge that I use examples of both Monster cable and some highly esoteric silver Van der Hull speaker cables,

for various laboratory speaker tests which we conduct.

To my surprise, I found that there were a whole new generation of speaker cables and interconnects available, which I was previously unaware of. Virtually all the major high-end demonstration suites at the Sahara Hotel displayed one or more forms of unusual cable connectors. Among the brands that I could easily identify, the most common being used were manufactured by Cardas, MIT, Goertz, Alpha-Core, Tara Labs and Audioquest.

Now before you turn your nose up and wager that those cables simply can't provide an audible improvement in sound quality, let me assure you that there are plenty of people around who are prepared to accept that wager. More critically, as I discovered, it appears that they *can* hear a difference and can correctly identify which cable is being used in a 'double blind' test.

Not only that, but the foremost exponents of this in the field have developed instrumentation which allows them to measure the differences to substantiate their claims. As I discovered, their theories abound, and they back them up with 'white paper' reports.

With few exceptions, the cables are large with unusual appearances. Whilst many use multiple spiral wound separate cables with external shields, others use some form of Litz wire, or even flat and wide silver strips. Some cables incorporate semi-conventional wiring configurations supplemented by passive components at one or both ends. They all share one common feature, in that they are without exception, *expensive*.

I couldn't help but feel that somewhere in there, the 'Emperor had lost his clothes'. However, rather than adopting a critical stance, I prefer to hold my ground until such time as I have had the opportunity to put one or more of those new products into a comparative test.

CD players

There were literally hundreds of new and exciting CD players on display. Amongst the more unusual was a Sony CD player, whose mechanism is reminiscent of a juke box, and which stores 100 CDs (see photo).

What staggered me was the lowly price to which CD players have dropped. At the Sharp display I was shown their lowest priced mini-system. It incorporated an amplifier, CD player, cassette player and radio tuner and a pair of speakers, neatly packaged for only US$100.

Sharp were displaying other inexpensive mini-systems for US$200, $300 and $400. With products being marketed as those sort of prices, I began to understand why mini-systems now outsell conventional hifi systems in the US by three to one.

Night viewers

One of the more esoteric group of products to be released at this year's CES were the ITT Night Quest 'monoculars' and 'binoculars'. As they explained, the Night Quest products were originally developed for the US Army, Navy and Air Force. The Night Quest glasses easily outperform the best carrots in inproving night vision, and provided the helicopter pilots and sharpshooters with the ability to literally 'see in the dark'.

Thus by way of example, on a pitch black night, using one of the ITT monoculars or binoculars, a sniper can clearly see a person in dark clothing at 200m. More importantly, they can hit them without themselves being visible. Under the same pitch black conditions, without the assistance of the Night Quest equipment, you would have great difficulty identifying your own hand 300mm from your face.

ITT created a lot of interest with its new Night Quest night vision viewers, which make use of technology until recently classified for exclusive use by the military. At an ITT demo, Louis was amazed at their performance.

I was intrigued to discover why ITT has commenced marketing a classified (if not top secret) product. The answer was simple. The Russians and the Israelis had developed similar products, and both were now marketing their products around the world. Obviously ITT no longer wished to be left behind, so they convinced the US Defence Department to declassify the product and follow suit.

Now the ITT Night Quest monoculars and binoculars offer a visual capability which is absolutely stunning. ITT demonstrated them in a large auditorium in which all lights had been switched off — other than a single red emergency egress light, 50m away in one corner. It was so dark that even after being exposed to this condition for 10 minutes, I still could not see the person sitting in front of me, or even the person next to me. Using the Night Quest monoculars however, and the cheapest model at that, I had no difficulty in seeing everything that was going on, and every person and object in that room.

The technology on which the Night Quest products are based is outstanding. The heart of the system is a minuscule disc, with a diameter of approximately 25mm, which has been formed from more than 80,000 parallel microscopic glass tubes. The outer faces are ground flat, before applying special electrodes on both faces. The inside of the tubes are also treated. The special disc is preceded by a group of conventional lenses. When a single photon strikes on one side of the disc and enters the appropriate tube, it triggers an avalanche of electrons which then move along the tube before being re-converted into an optical signal at the far end.

The end result is a dramatic and uniformly controlled amplification of the incident light, which maintains the form and character of the original un-lit objects, which you are then able to observe.

Each small monocular or pair of binoculars is powered by a pair of AA batteries. These provide a typical continuous operational life of at least 28 hours.

The question that most journalists asked was, "Did ITT expect to sell many?" — and the answer was of course, a resounding "Yes, every policeman will want one!". But I wasn't surprised when a smart alec at the back piped up "And so will every crook"!

Mobile nav systems

The last of the special purpose products that caught my eye at the show were the mobile navigation systems, designed for use in cars and trucks. Whilst Sony were displaying their latest and greatest system, I was more impressed by the Rockwell Automotive Path-Master system.

The PathMaster provides a turn-by-turn route guidance and information system. It appears to be the most intuitive 'user-friendly' vehicle navigation system to be developed. It interacts with the driver via a dash-mounted display unit, which has seven input keys and a 100mm-diagonal active matrix LCD colour screen.

The heart of the system is a compact GPS satellite receiver system, with an external antenna to collect vehicle positioning data which is then continually fed into the system's computer. The on-board computer is mounted either in the vehicle's boot or under a seat, whilst the detailed graphical information is stored in a separate database which is generally limited to the area in which you are working.

The database is innovative as it stores block by block addresses, five-digit zip (postal) codes and data on the type of roads, as well as critical information such as one-way streets, turn restrictions, and the number of traffic lanes. When touring, it provides information on the points of

interest, landmarks and direct information on airports, bus terminals, hotels, restaurants, tourist attractions, hospitals, petrol stations, post offices — and last but not least, tunnels and bridges.

TDK's $1M Challenge

On my last night at the CES, I was invited by TDK to observe the TDK Million Dollar Challenge — which did not form part of the show itself.

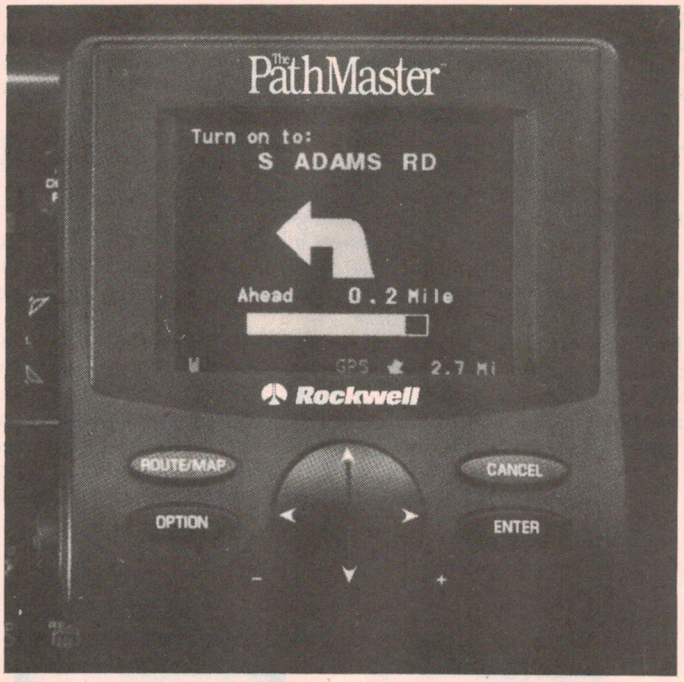
Sixteen competitors flew in from all over the USA to compete for the honour of being the person who could correctly pick, '10 out of 10', whether the sound they were listening to was the original CD, or a cassette copy recorded with TDK's SA Type II tape.

TDK handed the organisational side of the competition over to a separate firm, who in turn organised for one of the major accountancy firms to act as independent scrutineers.

The 16 competitors were wined and dined before being placed in the 16 booths, arranged around three sides of the stage. Each was provided with high quality headphones to deliver the audible source material.

While they literally 'faced the music', the 200 or more guests who were also in the room continued eating, drinking and talking. I only hoped that the contestants were not disadvantaged by the presence of that noise.

An additional set of headphones was available for any members of the audience who wanted to listen to the same program content being fed to the contestants. I availed myself of the opportunity to listen to four of the 10 tracks being played, and came to the conclusion that the music had been carefully selected. Of the four tracks that I heard, the normal telltale signs of breaks in the music or very quiet passages on which I would rely in part for supplementary clues were few and far between...



Rockwell Automotive was displaying their new PathMaster route guidance and information system for cars and trucks, which takes advantage of the GPS navigation satellite system.

I moved around to the control desk from which the competition was being organised, and was pleased to find that the test set-up and its equipment had been specially constructed for that purpose. The actual selection of original CDs or tape copies was controlled by a computer, with a random selection which was not identified to the people running the test, at that time. Only at the end of the test would the technician and the scrutineer know for sure whether the music that had been played was sourced from the original CD, or from the taped copy.

The best score achieved was seven out of 10, which I thought was quite commendable. The lowest score was three out of 10, which indicates that person was really guessing. Although nobody won the million dollar prize money, what the competition did reveal was that some people have considerably better and more acute hearing than might have been thought.

From TDK's point of view, the results only went to show that a high quality tape copy of an original CD is capable of providing superlative quality sound. Not so surprisingly, the same conclusion had already been reached by a large proportion of the market.

If it had been otherwise, then both the Mini-Disc and DCC would have displaced the ubiquitous Compact Cassette. The TDK Million Dollar Challenge reinforced what most of us already new, but did so with a marketing panache which you simply have to admire. ❖

Could this Queensland team have produced

THE SMALLEST CD PLAYER EVER?

Just before this issue went to press, we received the following brief details of an undoubted breakthrough in CD player technology made by a team of engineers working in North Queensland. Aware of its timely nature and always keen to promote Australian innovation, we wasted no time in preparing the author's account of the development for this issue.

by NALA SKOORB

Some very enthusiastic people up here set out to design and build the smallest compact disc player they could. It had been noted that some CD players had been built with a footprint smaller than a compact disc, but the disc projected outside that footprint. Our own team has now succeeded in reducing the size of the case to just 130 x 70 x 25 millimetres, with the disc entirely enclosed in the machine — that is, the lid of the player is closed while playing.

The breakthrough came when it was realised that the disc did not have to remain as a complete circle. A precision guillotine has been made, and the disc is chopped into two semicircles, with reference marks at the cut for mechanically matching and locating the two parts.

The half-discs are placed in the machine, parallel and facing, and do not move while being scanned by a single head — which swings back and forth in a semi-circle between the two parts of the disc, rotating by 180° on its own axis at the end of each semi-circular sweep. The two half-discs are mounted about 10mm apart, with the scanning head reciprocating between them, reading each half-disc alternately, one on the sweep in one direction, the other on the return sweep.

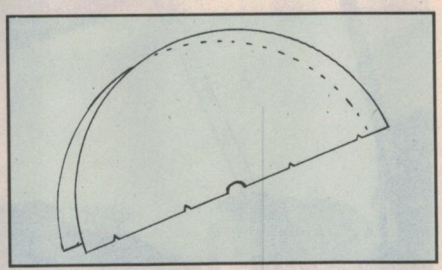
Fortunately it is not necessary to correct for this two-directional scanning, for the (nominally) righthand half-disc is scanned in the 'forward' direction, and the lefthand half-disc is scanned in the 'reverse' direction. If it were not so, then boustrodephonic (do I have the right spelling?) correction would have been necessary.

The loss of data in the vicinity of the cut has proved insignificant, and is handled in the same way wherein 'lost' data is recovered on normal discs, by digital error correction — making use of the Reed-Solomon encoding.

It was found necessary during mock-ups for the replay data to be temporarily stored in a 2MB dual-port RAM buffer, before being passed on for normal decoding. Proprietary equipment was used during early experiments to determine if the idea was feasible, but since then a custom surface-mount ASIC chip and five layer printed circuit board have been made to enable everything to be fitted into the small case.

The program on the chip which controls the machine requires the scanning head to first look for a track (or really a half-track) with either direction of scan, until one is located; the radius of that half-track is then 'remembered', and after the corresponding other half-track is located, mechanical corrections are made so that the half-tracks are played in the correct sequence.

Some mechanical balancing of the reciprocating head was found to be necessary, to overcome reaction vibration. It was obvious from considerations early in the design phase that the reading head had to sweep slightly past the edges of the half-discs, in order to accommodate slight discrepancies in the dimensions of the sliced disc. However it was not necessary to accommodate the acceleration time of the reading head at the end of each stroke; this has been taken care of in reading from the stored memory.



A major problem, which had a simple solution, arose when the first completed machine was put to practical test. It had worked satisfactorily as far as the experimenters were concerned, with smoothly reconstructed waveforms on the oscilloscope. But when a musically experienced outsider was called in for a critical assessment, they reported that the tune was unrecognisable.

A disc with a vocal recording on it was then tried, and the words were completely indistinguishable. Then the reason became evident: the fitter who had made the mechanical parts for the player had been unaware that CDs are read from the inside outwards, and had assumed that the data started at the outside edge of the disc. This was very quickly overcome with a few altered connections to the drive for the scanning head.

Just how this problem arose, when it is necessary for the data being read out from the disc to include recognisable table of contents information (e.g., the track numbers), has not been determined. But in the rush to get the machine working, no further investigations were made.

After some rebuilding (the work is being carried out on a very limited budget, and the luxury of completely new parts for each stage of the development was just not possible — compare with the Wright brothers, who did not keep the actual aircraft which first flew, but used parts of it in subsequent aircraft), the thickness of the player has been brought down to 25 millimetres, to accommodate the batteries and a very slim loudspeaker.

It is unfortunate that after successful testing of the player, no photographs of the machine could be made. The reason for this is that field testing was undertaken to assure the experimenters of the reliability of the design. The machine had been put in the shirt pocket of one team member, who on transferring from one boat to another, overbalanced and the machine fell into the sea at a place where the water is some 400 metres deep. So for the present, our only extant model of the most compact CD player has been lost.

It is worth recording that some thought was given to making an even more compact machine, one which would use compact discs cut into six sectors. But the added complication is thought to be excessive for the modest further reduction in size. It is believed that a CD player which will play while residing in an average shirt pocket is enough of an achievement. ❖

PARKES PREPARES FOR GALILEO'S CALL

Australia's well known 64-metre radiotelescope at Parkes in NSW is currently receiving a major upgrade, which will ensure that it remains in the forefront of the world's instruments. But the impetus for the upgrade has come from NASA's need to press the telescope into service later this year, as an additional deep-space antenna for picking up the tiny signals from its Galileo spacecraft, in orbit around Jupiter.

by GEOFF McNAMARA

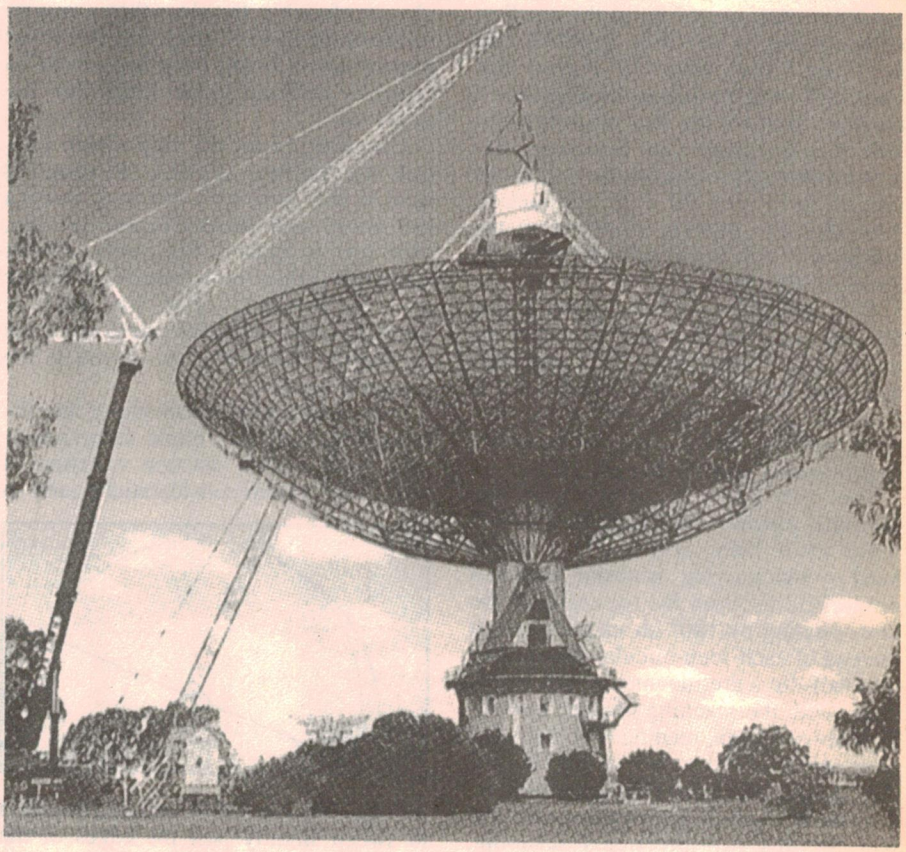
It's the biggest thing to happen at CSIRO's Parkes Radio Telescope in its 30-year history. For decades, the spectacular 64-metre diameter radio dish has been a world-class radio telescope and spacecraft tracking facility. Now it's set to become even more versatile.

Beginning in late November 1995, the Parkes antenna has been getting a radio telescope's equivalent of a face lift: a new set of receivers, a focus cabin twice the size of the old one, and perhaps most importantly, a device called a 'translator' that will allow the switching between receivers depending on the needs of the observations being made. The upgrade will make Parkes as versatile as any of the new radio telescopes emerging around the world.

The Parkes telescope upgrade has its origins in a near-tragedy for space scientists operating the Galileo spacecraft. Galileo is a dual-purpose mission, consisting of an orbiter and probe sent to explore the giant planet Jupiter and its environment. The probe has since penetrated the turbulent Jovian atmosphere, an experiment that the Australia Telescope took part in by receiving signals during the probe's fiery plunge.

The orbiter, on the other hand, is to spend 23 months exploring the Jupiter system, taking photographs and other measurements of Jupiter and its moons.

In order to transmit all that valuable data back to the Earth, Galileo was to use the orbiter's high-gain antenna, a five-metre diameter dish that was to unfurl like a metallic umbrella. But when the command to open the antenna was transmitted 18 months into the mission, it became painfully clear that the antenna wasn't going to open easily; after months of gently 'hammering' the antenna with its own motors, scientists resigned themselves to the fact that it was not going to open. Galileo would have to rely on its much smaller S-band antenna for relaying data back to the Earth.



The new and enlarged focus cabin being installed at the prime focus of the Parkes dish. The old cabin is visible on the ground at lower left. (Courtesy CSIRO Australia Telescope National Facility.)

Trickling in at a rate 1000 times less than is possible with the main antenna, the feeble signal would require the most sensitive ears on Earth to be heard.

"To maximise the data return we have to provide as much aperture as we can gather on the Earth", explained Peter Churchill, Director of the Canberra Deep Space Communication Complex (CDSCC) near Canberra. "We're already using the 70-metre antenna to monitor Galileo, but commencing in November 1996, at least two and sometimes three 34-metre antennas will be used in combination with the 70-metre, to capture the Galileo data. It's at this time that the Parkes radio telescope will be included in the array."

In a deal negotiated between the Australian Space Office, acting on behalf of NASA and the CSIRO, the Parkes telescope will be rented by NASA for ten hours a day for 13 months beginning in November 1996. At this time, the CDSCC will control Parkes from Canberra. "We will be installing four racks of Deep Space Network equipment at Parkes, which will be controlled remotely from the CDSCC", said Churchill.

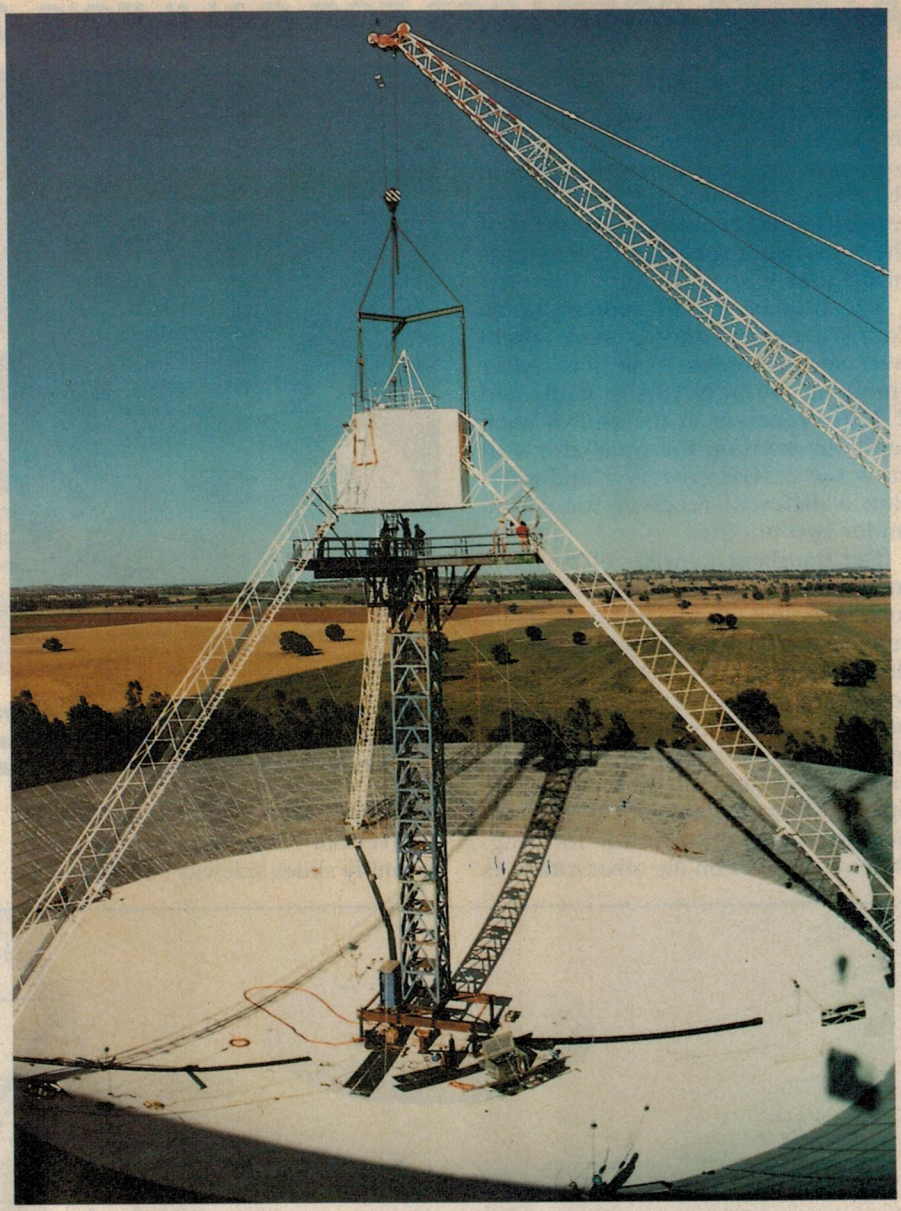
Despite such a large collecting area — the Parkes and CDSCC dishes combined provide the collecting area of a single dish 112 metres across — there were modifications to be made to Parkes to make it perform optimally. As Bruce Thomas, CSIRO's Project Manager for the Parkes upgrade explained, it isn't as simple as pointing the Parkes telescope in the direction of Jupiter: "Galileo is transmitting on a single frequency of 2.3GHz. Typical radio astronomy receivers go from 430MHz up to 22GHz."

The existing receivers just weren't suitable for the job, so as part of the NASA/ASO contract, CSIRO was asked to build the necessary receiver. "We're building a special receiver for tracking Galileo — an ultra-high performance, single frequency 2.3GHz receiver", said Thomas.

The low-noise 2.3GHz receiver built by CSIRO is being cooled to achieve a receiver system temperature just a few degrees above absolute zero. "The overall performance of a system is dependent on the maximum antenna gain, therefore the maximum antenna efficiency", explained Thomas. "Engineers usually talk about a signal-to-noise ratio, but in radio astronomy and space science it's the effective gain divided by the system temperature."

With this in mind, the receiver will be cryogenically cooled using two stages of cooling — 70K and 20K — with the low noise amplifier and associated waveguide components being at the lower temperature. This design will enable a receiver system temperature of just 5.5 Kelvin to be achieved, "which is a pretty high performance system", notes Thomas.

As Thomas explained, the 2.3GHz receiver required for the Galileo mission also has a very narrow bandwidth: "We've optimised the design at one frequency, rather than the normal design method of optimising for a very wide bandwidth. It's bandwidth versus performance: if you want very high performance you really need to restrict the bandwidth", said Thomas.



Another view of the new focus cabin being lowered into position on the support tripod. Note the temporary support scaffolding under the prime focus position. (Courtesy CSIRO Australia Telescope National Facility.)

While Thomas points out that the system performance will be "the best we've ever had at Parkes" the fact remains that the receiver would have been of little use to the major users of the Parkes telescope — the radio astronomers.

Translator needed

There was a problem with the old focus cabin on the Parkes dish. Only one receiver could be active at any one time, and it took about a day to change over a cooled receiver. The 2.3GHz receiver would need to be positioned at the focus in time for the critical period beginning November 1996, when Galileo starts sending back images and other data on Jupiter and its satellites. After that the receiver would have stayed put for the 13-month duration of the mission.

"If we'd agreed that NASA could use the antenna using the old focus cabin, they would have tied up the telescope for 13 months. I don't think CSIRO would have been happy with that — it would have been disastrous for radio astronomy."

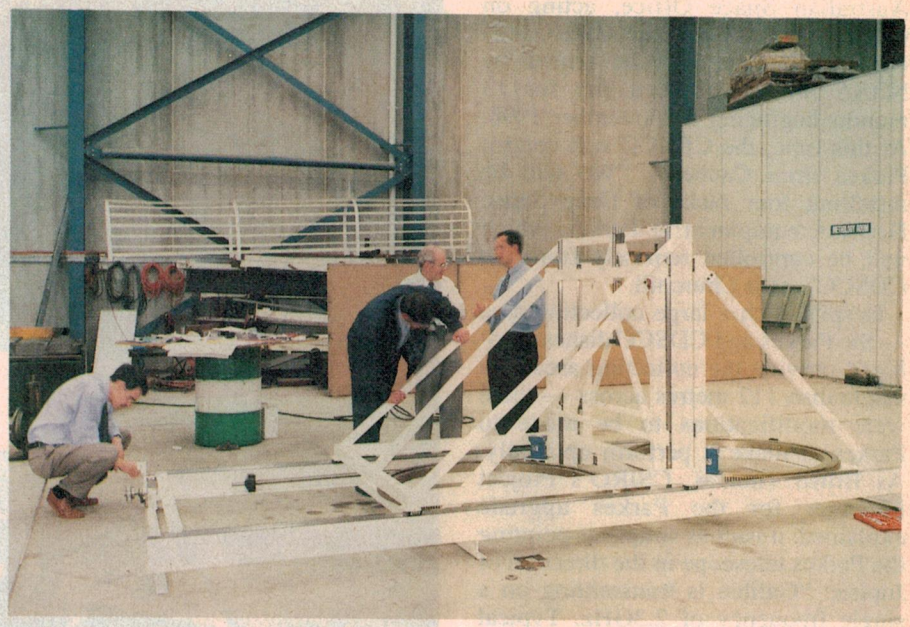
The only way that NASA and the radio astronomers could share the telescope time — NASA only needs the telescope for 10 hours a day — is to have some method of switching

PARKES PREPARES FOR GALILEO'S CALL

between the 2.3GHz and other receivers depending on the need. This led to the development of the 'translator', a mechanical device that sits in the focus cabin and is able to reposition different receivers at the focus of the telescope, depending on the needs of the user.

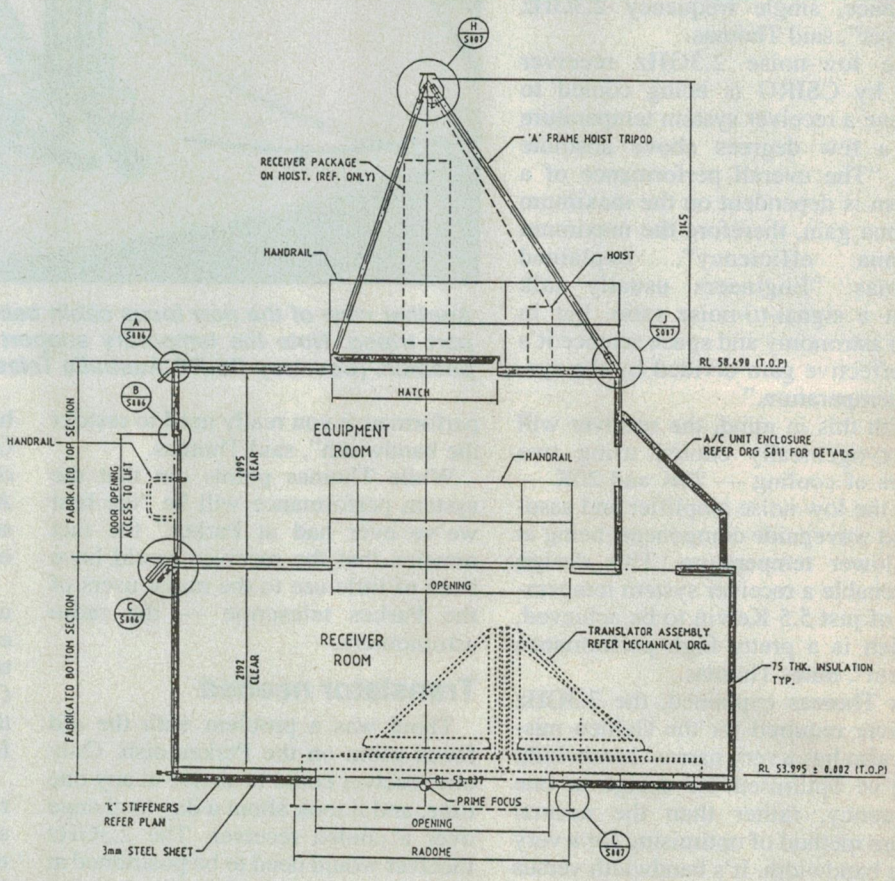
The translator will support up to four receivers and change them over at a moment's notice. After finishing with NASA's dedicated 2.3GHz receiver at the end of each ten hour session, the translator will stow the 2.3GHz receiver and position a different receiver for use in under two minutes.

The translator consists of two 1.2-metre diameter slewing rings or rotators, mounted side by side on a sliding support that lies parallel to the tipping direction of the 64-metre dish. Each rotator carries two receivers. When in position, a rotator can swing one receiver in line with the dish's radio axis. The rotator can also then move up and down to optimise the receivers position along the axis for focusing. When a receiver on the other rotator is needed, the first rotator simply lifts its receiver out of the way and the whole assembly slides sideways until the second rotator can place either of its receivers into position.

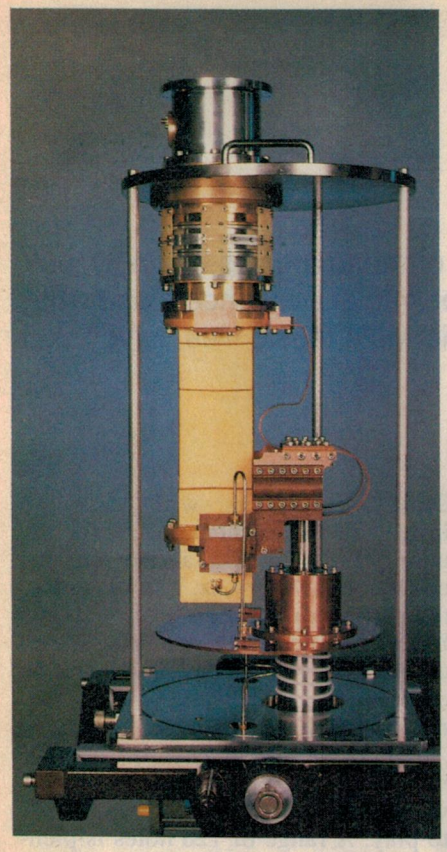


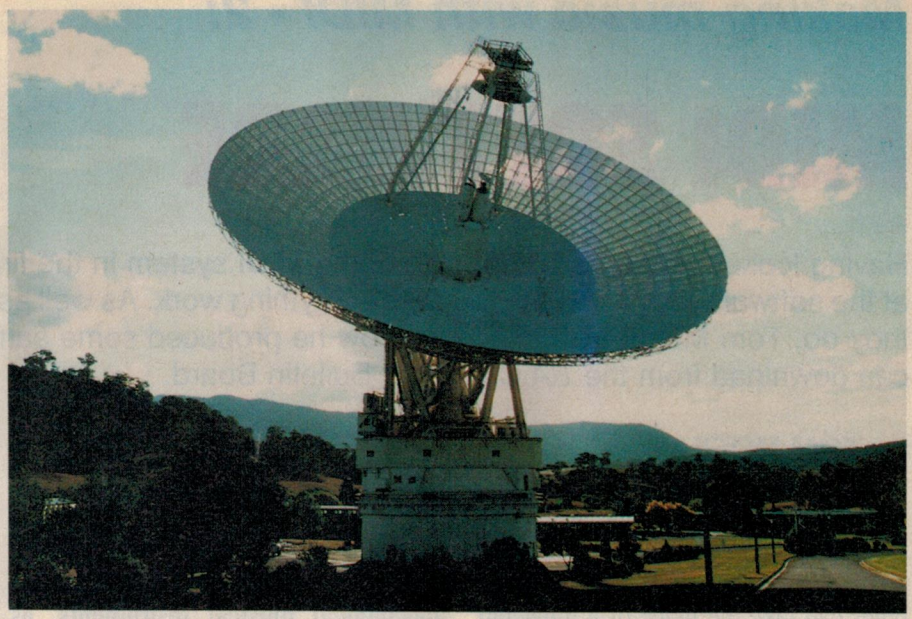
Above: The new translator during construction. It will allow very rapid changing of receivers at the telescope's prime focus, and also more accurate focusing. (Courtesy CSIRO Australia Telescope National Facility.)

But the translator has a second



A general drawing of the new focus cabin, now installed on the Parkes radiotelescope. The translator assembly allows rapid changing of receivers. (Courtesy CSIRO Australia Telescope National Facility.)





Above: The Canberra Deep Space Communication Complex's 70-metre antenna at Tidbinbilla. The upgraded Parkes dish will be used to augment its 'listening power', to receive the Galileo signals. (Courtesy Peter Churchill, CDSCC.) Left: The new narrow band 2.3GHz receiver, to be used for picking up the extremely weak signals from Galileo. In operation it is enclosed in a stainless steel dewar, and cryogenic cooling used to maintain crucial sections at 20K and 70K to minimise noise. (Courtesy CSIRO Australia Telescope National Facility.)

important role to play: keeping the receivers lined up with the antenna's focus. The translator, the receivers, and the necessary hardware ride inside an air-conditioned cabin which is supported above the dish on three 32-metre long legs. With so much weight suspended in mid-air, no amount of stiffening could prevent flexure of the telescope as it moves around the sky.

"The cabin containing the receivers moves away from the focus up to 50mm as the antenna tilts", said Thomas. "The dish distorts as well, causing the best-fit focus to move by a further 100mm." To compensate for this deflection, the translator can move the receivers in two dimensions. A dedicated control system calculates the optimum focus position and the translator moves the receiver accordingly. "The translator enables us to bring the feed and receiver back to the focus of the dish."

All this is no easy task, however: the weight of the receivers can be considerable. "It's possible to have up to 740kg of receivers", Thomas pointed out. "We're able to change receivers at any elevation angle, so that means the control system has to push this 740kg mass plus the rotator assembly up hill!"

To cope with such a heavy load, the translator is driven by five high-torque, brushless AC servo motors.

Heavy shielding

When you're straining to hear the faint radio signals from space — either from a distant cosmic source or from a stricken spacecraft — the last thing you need is interference from the instrument itself. The variable frequency drives which control the motors are enclosed in an RF-tight cabinet, to minimise such interference. Next to this cabinet is a second RF-tight cabinet containing the focus cabin control computer.

Other measures to keep RF interference to a minimum include well-screened control, sensing and drive cables, and extensive use of integrally filtered connectors. In addition to these precautions, most of the equipment can be turned off to create a 'quiet' operation mode if necessary.

New focus cabin

All this added equipment — the multiple receivers, the translator, and the controlling hardware — called for a much larger focus cabin. The old cabin measured 3.5 metres on a side, but the new housing is almost twice as large and has two compartments. The compartment nearest the dish is called the receiver room and contains the translator assembly, the control equipment and the main switchboards. The 2.2-metre height provides clearance for the receivers and feeds in the fully raised position. Below the cabin is a 3-metre diameter radome to keep the cabin completely enclosed. The radome also permits air conditioning of the cabin.

A ladder through the ceiling of the receiver room leads up to the equipment room, a similar sized compartment that accommodates power supplies and other equipment. A hatch in the roof is large enough to accommodate any of the receivers or even one of the rotators. Suspended above the equipment room is an A-frame hoist for raising and lowering equipment into either the equipment room or the receiver room.

The new cabin and its contents increase the weight of the antenna by six tonnes. To make sure the supporting structure beneath the dish could support the added weight, the structure was reinforced under each of the legs. The tripod legs themselves had to be lengthened to allow for the bigger cabin. To compensate for the added weight in the antenna, the dish's counterweights also had to be increased.

Continued on page 32

Making music with MIDI - 2:

MIDI SOFTWARE

Having looked at the hardware side of the MIDI system in the first of these articles, we now look at the software that's needed to make everything work. As well as looking at sequencers and what they do, Tom Moffat also describes how he produced some sample MIDI music files, which you can download from the *EA* Computer Bulletin Board.

by TOM MOFFAT

Last time we looked at how MIDI instruments work and what goes into a MIDI keyboard synthesiser or module. We only briefly mentioned that a computer can take the place of a musician playing a MIDI keyboard. This month we'll concentrate on the computer side of things, with special emphasis on some of the software schemes that can turn an innocent looking MIDI gadget into a sixteen piece band.

There's nothing new about automatic-playing bands, you know. I had a rave about some of the old-time mechanical marvels in a Moffat's Madhouse column back in 1992; among them the Nickelodeons in the USA and the Robot Dance Orchestra that lives in Sydney. With a lot of fiddling about with the computer and the 128 General MIDI instruments I was able to produce some reasonable 'player bands' based on these old mechanical musical instruments, as described later.

The basic MIDI computer music program is called a SEQUENCER. All it does is send MIDI commands to a synth or module or SoundBlaster card. The commands, usually two or three bytes long, first tell the MIDI device what instrument to use. Then they specify what notes to turn on and what notes to turn off, all in sequence.

The scheme is very simple and straightforward, really. Let's look closely at the structure of a MIDI command; three bytes, expressed in hexadecimal (numbers with base 16 instead of the usual base 10, for the uninitiated). To turn a note on, the command is: **9x yy zz**. The '9' means note on; x is a hex digit between 0 and F (0 and 15 decimal) specifying which channel the command is for — in other words, which instrument channel is to play the note.

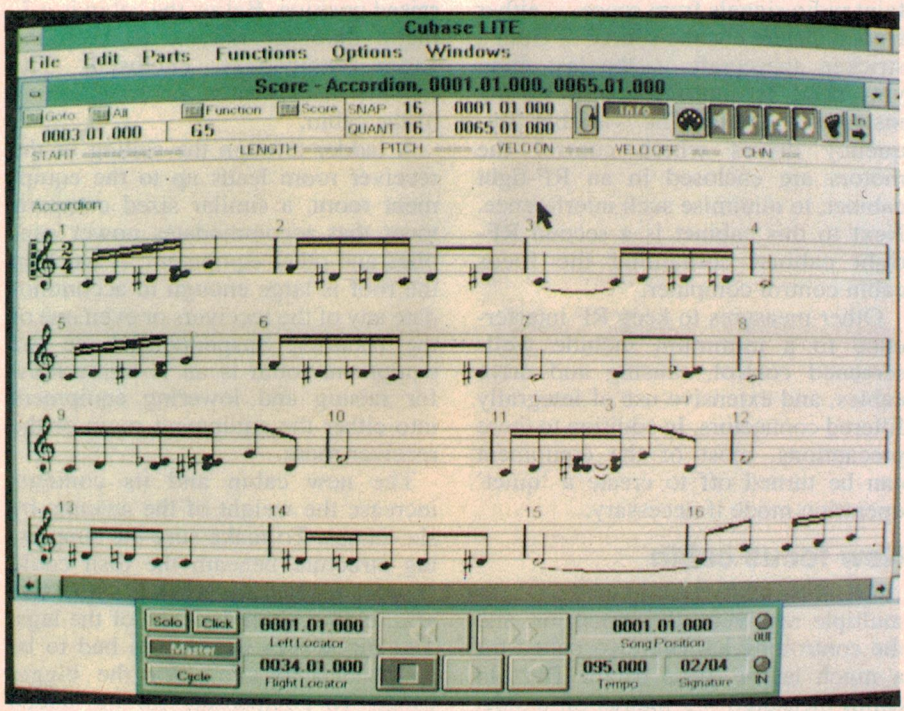
The yy parameter is a hex number between 0 and 7F (0 and 127 decimal) which tells the instrument which note to play. A range of 128 notes is plenty to cover from the lowest to the highest on any instrument, considering a piano only has 88 notes. The zz parameter specifies how strongly the note is to be played.

To send a note-off command, you simply substitute an 8 for the 9. How long the note is to play for is set by a simple time delay between note-on and note-off. For instance, to make the instrument assigned to channel 2 play the F note in the second octave on the keyboard, with moderate volume, you would turn it on with **92 35 50**. Next do a time delay for the length of the note, and then send **82 35 50** to turn the note off.

Should you want to play an F major chord, you would turn on the F, and then an A, and then a C. With all three playing you would do a time delay for the length of the chord, and then send note off commands for F, A, and C. With no delays between the three note-on's, they happen so fast that for all practical purposes they are simultaneous.

There are other commands, to do such things as select a new instrument on a given channel or to adjust things like overall volume or reverberation, but they all follow the same general format. Simple, huh?

Of course the MIDI user never sees these commands as such. Instead the



The notation editor in Cubase Lite, showing the accordion part for "Persian Rug". Notice the dud notes; the fourth note is actually three accidentally struck together. These can be fixed by the editor.

user loads the song to be played (usually from a file of type .MID). To set it playing there is often some kind of icon display on the screen representing the control panel of a cassette recorder — play, stop, rewind, and fast forward. An example of this control panel is the Media Player that comes as part of Windows.

The 'cassette player' becomes more interesting when it has a record button. Then you can 'roll the tape', go over to your keyboard, and play a song into the computer. When you are finished you can hit rewind, and then play, and marvel in wonderment as you hear your creation played back just as you recorded it — sour notes and all.

As the next step up, let's turn the simple cassette recorder into a 16-track Ampex studio recorder. We're now entering the realm of specialised MIDI music composing programs, such as Cubase and MIDI Workshop.

With this type of program you can lay down one track of music, say using the piano, and then spool back to the start. Next you can lay down another track, say a clarinet (played on the synth keyboard, of course), while listening to the piano part being replayed. Then you can play both of these back as you record a third track, maybe a guitar.

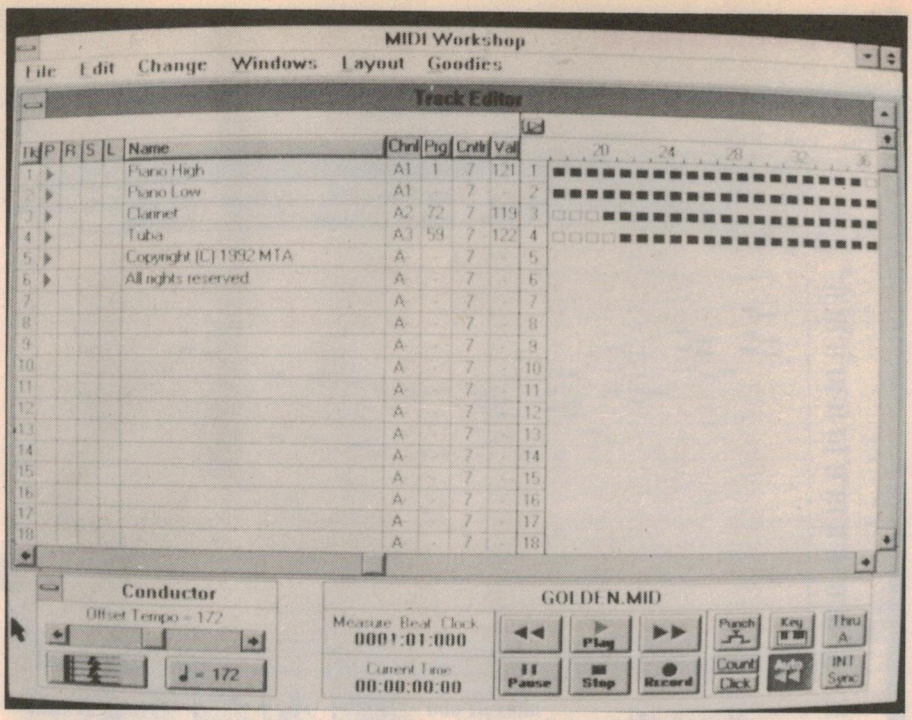
You can keep going over and over this recording, adding a new track each time, until you've got a 16-piece band, all performed by yourself.

Such a rough-and-ready performance is bound to have its share of dud notes in it, so you can now invoke a SCORE EDITOR to go through it track by track, editing out your mistakes and cheating in every other way possible. What you see on the screen is a score in proper music notation, and you can work with the notes just like you would with letters in a word processor — insert, delete, copy, cut, paste, etc.

This of course assumes you know how to read music. I have spent many years playing in bands in pubs, totally unable to read a note.

So the first time I tried one of these score editors and a sheet of music popped up on the screen, I just sat there and stared at it. I had a fair idea of the tune it was trying to represent, since I had just recorded the tune on the keyboard myself.

So I eventually took the bull by the horns and started deleting notes and adding notes and playing back individual measures, just to see what it sounded like. The upshot of all this fiddling



The track editor in Midi workshop. Each dark block is a measure containing some music. Light blocks are empty measures. Note "cassette recorder" controls at bottom of the display.

is that I am slowly learning to read and write music notation, by osmosis; it just sort of sinks in as I gain more experience with the editor.

As with a word processor, you can cut, copy and paste whole passages of music, much like with a whole paragraph of text. You can even cut or copy something from one of the 16 tracks and paste it to another track, making a second instrument play exactly what the first one played. This opens all kinds of possibilities of starting with a simple solo or duet tune as a MIDI file and turning it into a whizz-bang jazz band production.

Most MIDI programs make allowances for people who don't read music, but still want to edit note-by-note. Here each note is displayed as a horizontal stripe, its position up or down the screen representing the note's pitch, and the stripe's length representing note duration. This is exactly the way music for a pianola is recorded on a roll, so this feature is known as a 'piano roll editor'. You can use the mouse to move the stripes up or down the screen (select different notes) or lengthen or shorten the stripes.

Learning by doing

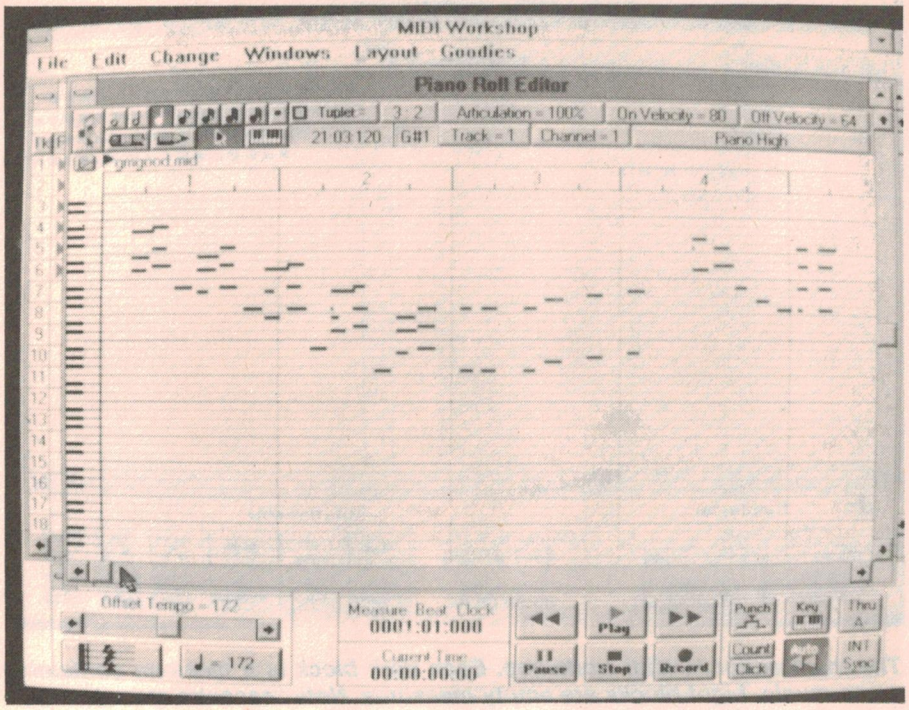
There is another class of sequencer which is read-only; it can't record or rearrange tracks. But it can play music normal, fast, or slowly; it can select a passage of music and play it over and over, and it can even show which notes are being played, on an image of a piano keyboard.

These programs are designed to teach you to play music, by imitating the playing of an expert musician who has recorded a MIDI file. So as well as learning to play the notes and the timing, you learn the style as well — something that just can't be expressed on paper with standard music notation.

I've been playing around with a couple of programs from PG Music of Canada. New Orleans Pianist contains a special sequencer program and a collection of 66 MIDI piano performances, in styles such as Boogie, Blues, R&B, Ragtime, and Gospel. Composers of this stuff include such memorable old timers as Jelly Roll Morton and Professor Longhair (one of my all time favourites).

The performances are recorded on a very highest quality, full sized MIDI keyboard, by five pianists most of us in Australia have probably never heard of, since they are Canadian. Most of them appear fairly young, and their playing is just out of this world. Some of the songs are actually composed by the pianists themselves; a fellow named David Torkanowsky has turned out some great stuff.

The other program, Jazz Pianist, contains a similar sequencer and 71



The piano roll editor in Midi Workshop. Notice the keyboard display on the left showing which 'holes' in the roll affect which notes. The music can be edited by direct manipulation of the length and position of the 'holes'.

MIDI files. Styles presented are not way out 'modern' stuff; they are more in the vein of stride piano, ballads, and cocktail piano.

In fact the program boots up ready to play that hoary old number from the film *Casablanca* — 'As Time Goes By'. (You remember, where Humphrey Bogart gazes into Ingrid Bergman's eyes and says "Play it again, Sam", or something similar). The version in Jazz Pianist is quite a bit nicer than the one in Casablanca.

Jazz Pianist also features some 'trio' type tunes, in which bass and drums are added to the piano performance.

While you first play a MIDI file to get the feel of the tune, both programs display a panel containing a photo of either the composer or the performer of that tune (that's how we know they are young) and a bit of blurb about the history of the tune. You can also call up different screens to get more detailed biographies of any of the composers or performers. There's even a music trivia game.

You are meant to learn by copying what you hear, and by watching what keys are pressed on the keyboard display across the top of the screen. It is also possible to call up a music notation display as the tune is being played, and the Jazz Pianist program even displays the names of the chords being used.

I have worked out my own method of using these programs. When first starting to learn a song, I listen to it a few times and then work out a fairly simple version, played in the same key as the MIDI file. If you're really a wimp you can make the program transpose any of its songs into the key of C, but that's considered bad form...

Once I've got a simple version of the song down pat, I then try to pick up some of the style of the original by selecting bits and playing them over and over, trying to echo them on the keyboard. This is time consuming, but it gets you there in the end.

Some of the pianists' tricks are rather unique; in one ragtime piece from New Orleans Pianist, the trainee player is instructed to whack the lower end of the keyboard with the left elbow. The student is warned that this shouldn't be attempted during performances in pubs while the owner is watching, or the pianist might not be playing there any longer.

Both these programs are jolly good fun, and a good way to do something useful with your keyboard (you've got to justify all that money somehow... piano lessons?). I understand they are available from music shops in Australia for around $59 each. There's a further program, which I haven't seen, which teaches guitar using the same methods.

Computer stuff

Atari, Commodore Amiga, Macintosh, and IBM-PC computers are the ones favoured for music production. Many years ago (maybe even pre-MIDI), I remember seeing an Atari computer in a Hobart music store hooked to some kind of synthesizer and a C-Itoh printer for printing out music scores. That amazing (and expensive) setup was probably a lot less sophisticated than the SoundBlaster systems being given away with IBM-PC compatibles purchased today.

Macintosh seems to be preferred by professional musicians, who see the computer as a necessary tool rather than an item of interest itself. Those who use the IBM-PC for music probably had the computer first, and then got interested in its music capabilities via the included SoundBlaster.

As well, the PC seems to reign supreme in the really high-end music and/or multimedia applications. Just a couple of weeks ago I saw a demo by a guy who produced radio commercials for a living. His 'studio' was a Yamaha MIDI module and an IBM-PC which could edit sound digitised onto a hard disk, as well as MIDI music tracks, all at the same time. It's the same sort of stuff we used to do with two tape recorders back in my own radio days. The new method is much easier, and much more precise.

It should be pointed out here that music software running on the PC under Windows can be a little troublesome. This is because the software must output a constant data stream to the MIDI device under very tight timing constraints. At the same time the computer must carry the heavy burden of Windows, which is demanding its attention in all directions to the detriment of the task at hand — making music.

You'll know you've got Windows problems if the music tempo seems to stumble occasionally. The solution is to disable most of Windows' functionality by starting it in the standard mode instead of '386 Enhanced' mode. This is done by starting Windows with the command 'WIN /S' instead of just 'WIN' or 'WIN /3'.

If your computer automatically

comes up in Windows when switched on, then you'll have to totally exit Windows back to the dreaded MS-DOS command line and restart it with WIN /S. It's a pity music software doesn't come in DOS versions in the first place; it would be a lot less clumsy.

Practically music

Before we go any further, I must advise you that we are now delving into what may be a 'first' in magazine publishing — an article you can listen to as well as read. Here we will discuss some practical examples of MIDI production, many of them attempts at reproducing the sound of the early mechanical music machines.

Each song mentioned has been put into a computer archive file 'TOMSMIDI.ZIP' which you can download from the *Electronics Australia* computer bulletin board, phone number (02) 353-0627. You can play these as you read about them if you have at least a SoundBlaster-type card and something like the Windows Media Player. OK? now load 'PERSIAN.MID' and press play.

PERSIAN.MID: This is the old song about 'On my Persian Rug...' in a version played by the Cheap Suit Serenaders. This interesting band is led by cartoonist Robert Crumb, who draws those 'Keep on Truckin' figures as well as little bubble-headed characters in various states of stoned-ness.

'Persian' is an example of playing an instrument onto an individual track while listening to the others playing back, as described above. Instruments are accordian, fiddle, banjo, piano, drums, and a bowed cello used as a bass. Persian Rug has long been a favourite of the Burglar's Dog band I play with, so I already knew the accordian part.

Trouble is, trying to play an accordian part with chord buttons, onto a piano keyboard without chord buttons, ain't easy. It's even more fun trying to play fiddle, banjo, cello, or drums, when you don't in real life play any of those instruments. The original Cheap Suit Serenaders version doesn't have a piano, but I decided to bang a few chords into it anyway just to fill out the sound. This was improvised on the fly, one take only.

The MIDI file presented herewith is exactly as recorded without any editing at all, since I didn't know how to edit at that stage...

It was my first go at MIDI recording, produced over half an hour or so, and rough as guts. Your own first attempt will probably be much better.

ENTRTAIN.MID: Scott Joplin's 'The Entertainer'. This is an example of a Reproducing Piano, in which the intensity (touch) of the notes is recorded as well as the pitch. The result is a pianola deluxe.

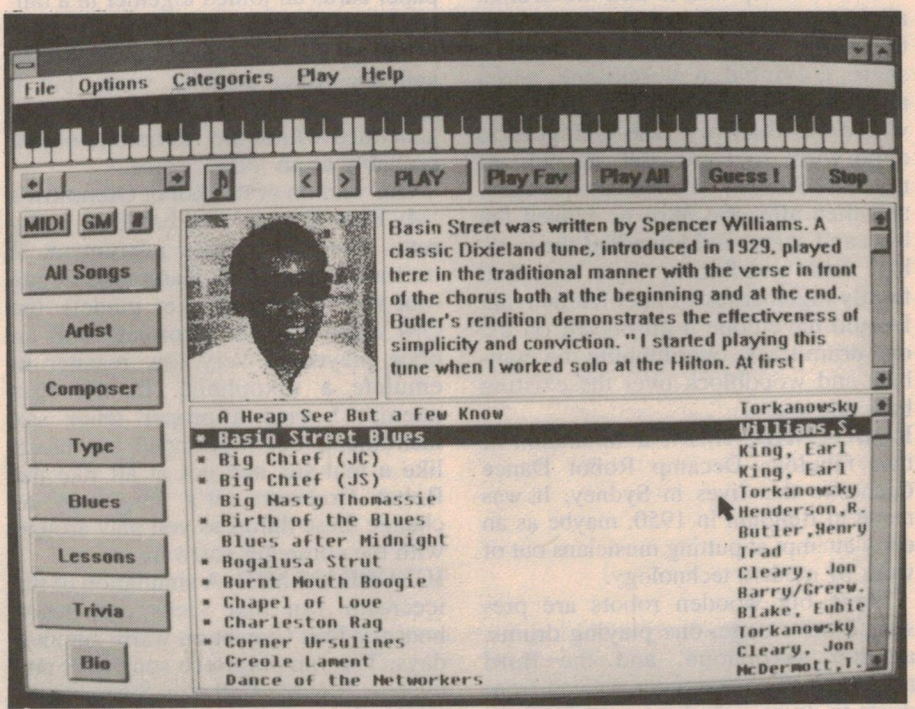
However the song sounds rather mechanical, with absolutely perfect timing and tempo and very little 'feel'. I suspect this recording was never actually played by a musician, rather it was 'sequenced' by someone manually entering the notes into a score editor, possibly copying them laboriously from the sheet music. Still, The Entertainer sounds pretty good, especially on that Bosendorfer concert grand piano in the Korg. The file came from the Internet.

NICKELOD.MID: This is my attempt at reproducing the sound of a Nickelodeon, the predecessor of the juke box. You'd put an American five-cent piece (a nickel) into a slot and the machine would burst into a frenzy of ragtime piano, accompanied by things like a violin, mandolin, and drums, all played by mechanical and pneumatic means.

The machine I was trying to emulate was the one in the arcade in Manitou Springs, Colorado, that I raved about in the Madhouse column mentioned above. I visited that same arcade during a journey back to the USA in December 94. The arcade, the pub, and many of the old games were still intact. But alas the Nickelodeon was gone. So its sound had to be reproduced from a 40 year old memory...

I started with another traditional four-section piano rag, STLOUIS.MID, from the Internet. As with The Entertainer above, this was presented as two MIDI tracks, one for the melody and the other for the accompaniment. It was obviously laid down in two stages, and from the sound of it, a live musician was involved. To turn this St Louis Rag into a nickelodeon piece, I added a violin and drums to the piano. I also wanted to include a mandolin, but I could find nothing in the General MIDI scheme of things that came close to a mandolin, so I gave it a banjo instead.

Each of the four sections of the rag is played twice. In each case I let the piano go on its own for the first time through, and then brought in one of the added instruments for the second playing. In section one of the rag, I stole the violin part by cutting it out of the piano melody track and then pasting it into the violin track. This meant the violin was then trying to play several notes at a time, piano style. It didn't sound very violin-ish, so I used the score editor to go through



New Orleans Pianist, ready to play Basin Street Blues. Note the panel containing a photo of the composer and information about the song, and the piano keyboard at the top. The keys light up as they are played by either the computer or the student musician.

the violin part note by note, cutting multiple notes to leave only singles. Trying to figure out which ones to cut and which to leave was an interesting exercise, for a non-reader of music.

In section two of the rag, the banjo gets to solo in the second half. This was done by the same procedure as above, stealing the corresponding piano melody track and hacking it. This time I let the banjo player keep the occasional multiple notes, and even one strum.

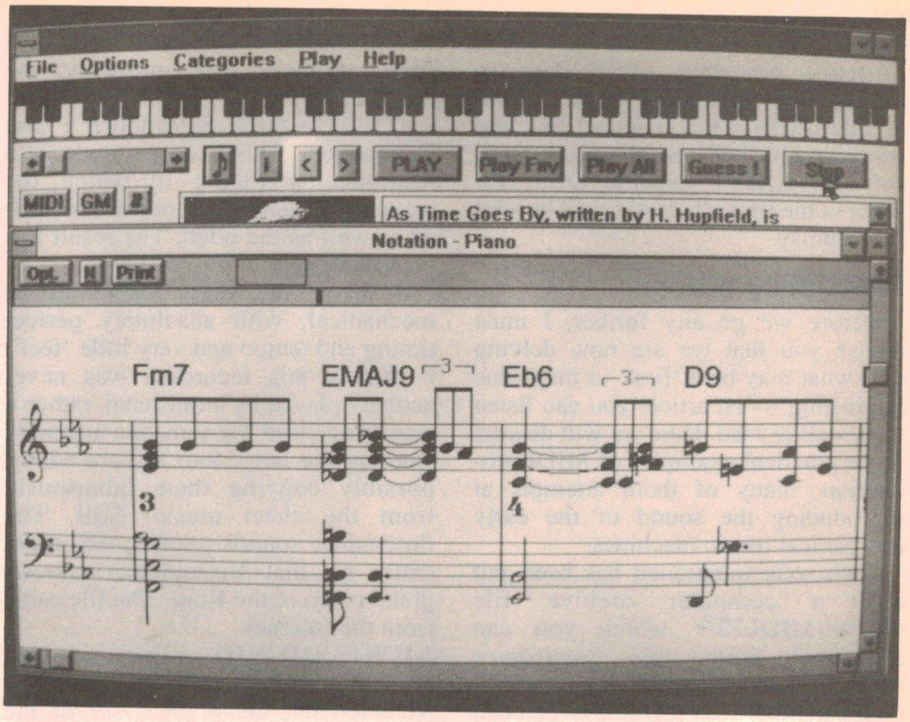
By section three I had decided these newcomer instruments had had enough solos, so the violin was made to play a counter-melody along with the piano melody. Consequently this was original work on my part, a keyboard job. Fairly slow, so not real hard to play. And I thought it sounded rather nice in the end...

Finally to section four, and the grand finale. Another counter-melody from the violin, this time joined by the banjo, as well as both piano parts. I decided to give the banjo a little bluegrass-style picking to do, and I must admit it was all too fast for me to play properly on the keyboard. No problem — just slow the song down to half-tempo during the recording and then replay it normally.

The last step was to add the drums, all in one go, for the full length of the song. It needed bass drum, a snare, a cymbal, a woodblock, and a mighty cymbal crash at the end. This was more than my feeble fingers to cope with, so I enlisted the help of my son Steven. We rolled the 'tape' and then after the intro he played the bass and snare, and I handled the cymbals and woodblock. This is called family togetherness. I later learned that I could have done it all myself on the one drum track, overdubbing the cymbals and woodblock over the existing bass and snare.

ROBOT.MID: This is a simulation of that fabulous Decamp Robot Dance Orchestra that lives in Sydney. It was made in Belgium in 1950, maybe as an early attempt at putting musicians out of work by modern technology.

Three big wooden robots are presented on a stage, one playing drums, another saxophone, and the third accordian. The drummer rotates from drum to drum as he beats out the time, the sax player stands up every time he plays and sits down again during his rests, and the accordian player seems to have about 20 fingers on his right hand and none on his left. But boy, can he play that right-hand keyboard!



"Play it again, Sam" — the Jazz Pianist program, rendering As Time Goes By. The notation display shows the third and fourth measures. The tune is played in E-flat, and appropriate chord names are displayed. The score can also be printed out.

The basis of the Robot Orchestra seems to be the innards of an elderly Hammond Organ, played by punched paper cards all joined together in a fan-fold configuration. The cards also control the robots' movements. The drums and accordion actually work, but it appears that the saxophone sound is generated within the Hammond organ, probably as an 'oboe' voice.

Our version of the Robot Orchestra's 'My Blue Heaven' was based on a cassette recording of the instrument. It uses a General MIDI Hammond Organ (not the rotating speaker model), the GM drum kit, an accordian, and an oboe played in very low register to emulate a saxophone. In the first attempt I tried a proper tenor sax instrument, but it sounded too much like a real sax and not at all like the Robot Orchestra. It's very easy to change these things as you play around with the computer software.

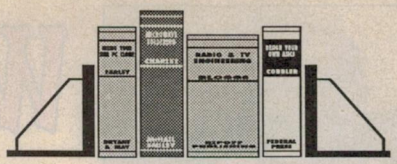
ICECREAM.MID: A simulation of the icecream van that visits our beach house at Port Cygnet on warm summer days. The van plays one song over and over — 'Let Me Call You Sweetheart', on an electronic gadget which is emulated by MIDI instrument 80, an ocarina. In the recording you hear the icecream van coming along the road with seagulls (MIDI instrument 124, birds) in the background. You can also hear the refrigeration unit's compressor going (MIDI instrument 126, a helicopter effect).

When the driver sees some kids, he stops the van and the music stops too — but not before the last note is played terribly flat, possibly because the voltage from the alternator droops. The compressor keeps running as the man serves the icecream. Then the music starts and he is away again. This MIDI file is a real summertime nostalgia piece.

STJAMES.MID: Saint James Infirmary, from "New Orleans Pianist". This is an excellent recording, played down and dirty and very moody. It's full of feel and has excellent dynamics. It sounds like one of those things the pianist never plays the same way twice; it changes with his feelings at the time. The tune retains the dirge texture all the way through, and finishes the last couple of bars with a few notes from the Funeral March. If only I could play like that!

Well, I hope that little lot inspires you. I've got a feeling it's going to embarrass me — as I said, some of my own MIDI playing is a little rough. But if I practice, and if you practice, maybe we'll all be good muso's eventually — courtesy of computers and the wonderful world of MIDI. Have fun! ❖

NEW BOOKS



Servicing manual

ELECTRONIC TROUBLESHOOTING & REPAIR HANDBOOK, by Homer L. Davidson. Published by Tab Books (McGraw-Hill), 1995. Hard covers, 242 x 195mm, 1072 pages. ISBN 0-07-015676-X. RRP $140 (NZ$181.95 incl. GST).

This latest book from well-known US technical author Homer Davidson is a veritable tome, with 43 chapters and well over 1000 pages. It's intended to help the beginner master the practical side of electronics, and become proficient in electronics servicing.

It starts by introducing components and circuits, and progresses to cover test instruments, basic troubleshooting techniques, safety considerations, dealing with intermittent faults and so on. The emphasis throughout is on the practical side, with theory covered only incidentally and as needed to understand fault diagnosis and testing techniques.

A wide range of equipment is covered, from radios and TV receivers through to tape decks, VCRs, CD players, remote controls and microwave ovens. At first sight the chapters seem to jump back and forth mysteriously between the various kinds of equipment, but the intention seems to be a gradual progression towards a deeper knowledge of servicing techniques, bringing with it the ability to deal with trickier types of fault — wherever they are found.

Overall it seems to be well written, and there are plenty of illustrations (although some could be provided with more accurate or helpful captions). And while the main emphasis is on the products found in the USA (only NTSC TV receivers are discussed, for example), there's still a great deal of material that would be of equal value to readers over here.

For those wanting a comprehensive and down-to-earth manual on servicing, then, it's well worth considering.

The review copy came from McGraw-Hill Book Company Australia, of 4 Barcoo Street, Roseville 2069. (J.R.)

Disk drives

FLOPPY DISK INTERNALS, by Rajneesh Kapur. Published by BPB Publications, 1993. Soft covers, 180 x 232mm, 107 pages. ISBN 81-7029-480-0. RRP $14.95.

This is another in the range of low cost books from New Delhi publisher BPB Publications. It deals only with floppy disks for the IBM compatible PC, and is claimed to give the reader enough information to repair bad diskettes, copy protect them and even make a floppy diskette 'do whatever you want it to do'.

The first chapter introduces the floppy disk and gets into sector layout, organisation and even gives a listing of the code found in the boot sector. The next two chapters describe the basic differences between hard and floppy disks, and the factors affecting floppy disk performance. Both 5.25" and 3.5" floppies are covered, along with data encoding.

Chapters 4 and 5 look at disk controllers and how to program them. Program listings are in assembly language, so you really get right down to the nitty gritty. The listings are annotated, and if you understand Z80 code (and its later derivatives), you'll get a lot out of this chapter.

Chapter 6 is titled Making Bad Floppy Diskettes Reusable, although most of the techniques described are very simple and probably not worth the effort nowadays. Copy protection techniques are described in Chapter 7.

The level will suit anyone with a knowledge of assembly language programming, and while it's not a thorough treatise it does give a lot of useful information.

The review copy came from Jaycar Electronics, and is available from your nearest Jaycar store, catalog number BM2492. (P.P.)

Valve history

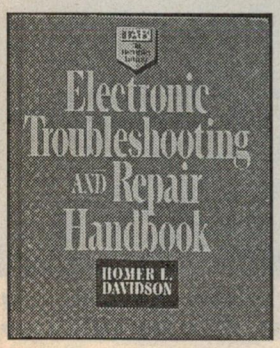
ILLUSTRATED HISTORY OF PHILIPS RADIO VALVES TO 1935, Second Edition, by Fin Stewart. Published by the author, 1995. Soft covers, 298 x 212mm, 60 pages plus covers. ISBN 0 646 23757 8. Price $25 plus P&P (NSW $2, interstate $2.65).

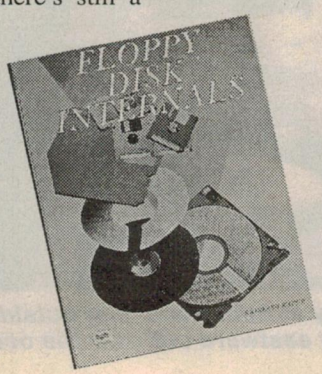
Australian Fin Stewart is a keen radio valve historian, and in 1980 he published the first edition of this book tracing the history of valve manufacture by Philips. It proved quite popular among vintage radio enthusiasts, and all copies were sold. But ongoing requests plus the recent renewal of interest in the field have prompted him to produce this somewhat enlarged second edition.

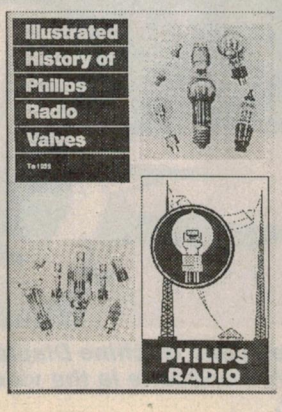
Like the first edition it begins in 1891 with the founding of a lamp factory in Eindhoven by Gerard Philips, and follows the success and growth of the firm through to the manufacture of its first valves in 1919. Then it covers valves of increasing sophistication and complexity, in this edition up to about 1940. There's a reasonable amount of informative text and tabulated data, and quite a lot of pictures — although these are often rather disappointing. They're all in black and white, and many are so contrasty that a lot of detail has been lost. As a result they wouldn't be of much help to someone seeking to identify particular models, for example.

It's definitely not in the 'beautiful coffee table volume' category, but there's a considerable amount of reference material for anyone with an interest in this key area of radio and electronics history.

Copies are available directly from Fin Stewart at 1 Perouse Avenue, San Remo NSW 2262. (J.R.) ❖







When I Think Back...

by Neville Williams

Old-time Music Machines: a surprising collection, in a spectacular situation

In a recent visit to the Southern Highlands of NSW, I stumbled upon what may well be the largest private collection of vintage music machines in Australia. What's more, poised on a rocky outcrop only a couple of hours up the Hume Highway/Expressway from Sydney, it offers one of the most scenic vistas in the state...

It all came about because, as a family, we needed a break from household routines. Not a prolonged fishing-touring-athletic holiday; just a few days in a comfortable room in a hotel/motel, with someone else to do the chores and worry about the meals. If it was cold or wet, we could linger in or on the bed. Warm sunshine, on the other hand, might lure us out into the surrounding countryside.

What better locale to consider than the Southern Highlands of NSW which, given the springtime rains, could be expected to offer colourful display gardens, broad green pastures and lush bushland...

From NRMA literature, we selected the Ivy Tudor motel in Bowral — which, with its own setting and associated Tudor styled restaurant, proved to be an acceptable and economical 'home away from home'.

On the way through Mittagong, we had picked up a random handful of brochures from the Visitors Information Centre in Winifred West Park, just off the Hume Highway. They offered plenty to interest the women folk, in the way of craft shops and displays; but not so much for 'Pa' beyond the Bradman Museum, an old book 'antiquariat' — and, out Robertson way, an exhibition of Old Time Music Machines.

As things worked out, I only got to visit the last named because we happened to find ourselves at Robertson, with the Music Machines only about 6km further on along the Illawarra Highway leading to the Macquarie Pass.

On arrival, a modest notice invited visitors to pay $4 each to inspect the display and enjoy the view (refreshments extra). 'Please sound your horn', it said — presumably to alert the occupants of another visitor!

As far as I knew 'the view' was as from the parking area itself — of rolling hills, essentially no different from what we had enjoyed en route. Nevertheless, we did as bidden and sounded the horn.

Almost at once a lady who introduced herself as Dawn Neels appeared and apologised that her husband, Kevin, "was down working on a new boardwalk". He would show us around the museum in a few minutes

The patio and tearoom at the Old Time Music Machine Display at Robertson, just outside Sydney, NSW. Beyond it is the vista to the north-east. Pictured opposite is the view eastward out over the ocean. Note the free-range animals in the immediate foreground.

— but in the interim, we might like to have a look at the view.

Coastal vista

In the meantime, it was evident that creatures great or small were also signalling our arrival, as evidenced by a chorus of 'hellos', 'hellow cocky' and invitations to 'scratch cocky's comb'! A small deviation revealed several large cockatoos in an aviary — plus a caution from Dawn not to accept their invitations, because they were liable to grab probing fingers in their formidable beaks.

As far as the Neels were concerned, they were presumably a preferred alternative to barking watchdogs!

We were thereafter conducted down a sidewalk into what was essentially a large glassed-in verandah, facing east and set up with tables and chairs as a sunny tea room. And from there, through the windows, was 'the view' — certainly nothing like that from the parking area by the roadside.

The house and verandah, we realised, were perched on a rocky outcrop of the mountain range which overlooks the flatland fringing the eastern seaboard of NSW. Immediately beyond the house, the property sloped down to grass-covered hillocks which had been cleared of rocks and scrub and replanted to pasture deer — plus as many native animals as fancied the environment.

In the middle distance other similar mountain spurs punctuated the coastal plains to the north and south. Out beyond them, forming the horizon, was the ocean. And that distant smudge of blue, due east of where we were standing? That was Lake Illawarra, a popular holiday resort — as viewed from 20 or more kilometres away!

By this time Kevin had arrived and pointed out that, on a clear day, with binoculars, one could make out Centrepoint Tower in Central Sydney, visible over the outcrop on the far left.

Dawn had already drawn our attention to Lake Illawarra. South of that were the plains behind Nowra and, to the extreme right, we would be looking out over the Bateman's Bay area. As I indicated, quite an extensive vista!

An 'impossible dream' that became a reality. Kevin Neels, now in his mid sixties, photographed in the forecourt and shrubbery that occupies the Neels' family site atop a mountain outcrop at Robertson, NSW.

Picturesque rail link

About 100m down from the house and partially hidden by shrubbery was the railway line. Railway — what railway? Ah yes, the once controversial freight line that links Port Kembla to Moss Vale, from where it has convenient standard gauge access throughput NSW and to Brisbane, Melbourne, Adelaide and across to Perth.

Kevin said that the link carried from one to three trains per day, mostly comprising two powerful diesel/electric locos and 40 or more modern double-bogey freight waggons. They carried coal, wheat and other bulk loads

to and from ships berthed in Port Kembla. He had been told that such a train, carrying a full load down the mountain to Port Kembla, could wear out a set of brake shoes in one trip. On arrival, new shoes had to be fitted.

The link was also available to vintage passenger trains travelling from Sydney Central to Moss Vale via the main southern line, then across to Port Kembla, and back to Sydney via the south coast line. At best, the train would be hauled all the way by the historic, green, streamlined 3801; but if this was in demand elsewhere, a vintage old black steam loco might be used instead. In mid summer, when a stray live coal could start a bushfire, the operators might substitute a suitably elderly diesel loco.

At this juncture, it seemed appropriate to turn our attention to what we had really come for and inspect the old time music machines, housed in a separate and quite large rectangular building. Here we were in for another surprise.

Instead of a rather sparse display, old time sound machines were stacked closely on shelves against all four walls, with labels, literature, records and sheet music. Down the centre of the building there were two — or was it three? — further rows of shelves, again crammed with music machines and memorabilia — plus oddments of other memorabilia which Kevin and Dawn hadn't had the heart to discard. More about those later.

Tinkle, tinkle...

Appropriately, for a display of music machines, we were shown two or three music boxes that pre-dated phonographs. At a formal dinner, they would provide a gentle tinkling background for the hush that preceded the first course.

The most common type had a central rotating cylinder, spring driven, with an ordered array of pins protruding from its surface. As the cylinder rotated, the pins would pluck springy reeds not unlike those in an harmonium, each sounding a particular musical note.

By such means, a music box could play a familiar tune, or even a number of tunes by interchanging cylinders.

Ironically, one of the music boxes on display was surmounted with a tiny make-belief turntable and soundhead,

Before the phonograph — a novelty music box. A spring driven mechanism rotates the 'sails' while also driving the spiked roller which plays a tune by plucking 'reeds'.

which would have suggested to a casual onlooker that they were listening to a tiny gramophone.

A more decorative example was built into a model windmill. The same spring which drove the cylinder also drove the sails, combining a peaceful continental image with a gentle sound. What an idea for a modern cassette lookalike!

An 'Edison Standard Phonograph'. In 'mint' condition, it is loaded with a blue celluloid cylinder (carton in foreground). On the wall behind is sheet music and brochures from the period.

Edison phonographs

From music boxes, our attention turned to Edison type cylinder phonographs, with the normal expectation of seeing two or three now-rare examples, plus a half-dozen or so cylinders. But Kevin Neels had far more than that to offer. When I thought to keep count or tabulate them in some way, it was already too late to start; but there must have been a dozen or more, in groups scattered around the display.

I did note that the oldest one was an original Edison player dating back to about 1905. It was still functional, ready loaded with a cylinder dated 1899!

The smallest example was in a group of 'portable' machines, cylinder and disc, with 'portable' signifying — in this case — small enough to move easily from room to room.

At the other extreme was a handsome 'Edison Standard Phonograph' in a polished wood table-top cabinet, plated mechanism and handsomely finished horn. By way of further embellishment, it had been loaded with a cylinder that had been either coated with or made from a blue celluloid-like material.

As we walked up and down the aisles, Kevin chatted on about brand names and models, occasionally turning one on to illustrate what he was saying. Clearly most of the machines worked, most were fitted with records, and he knew instinctively which lever or handle to push or twist.

On the wall, at the far end of the room, were several glassed-in shelves, each containing 100-odd cylinders in their original cylindrical cardboard cartons.

Most appeared to carry the Edison brand. Fairly obviously they had been collected and treasured by an enthusiast, the best part of a century ago and had escaped the fate that has long since befallen most other such collections.

Elsewhere, Kevin demonstrated a rare example of an Edison 'Diamond Disc' player, based on Edison's own version of a disc system, using vertical (depth) modulation and played with a diamond stylus. For its day, it offered

outstanding performance but suffered the penalty of differing from what had become the standard format.

To round off Edison's contribution to music machines, Kevin pointed to what looked rather like a cylinder phonograph but adding: "It's not really all that old; it's a Dictaphone". Suddenly, history seemed to have become less remote.

My mind flicked back to the early days of this magazine — then *Radio & Hobbies*. About the time I moved into the editorial chair, L.B ('Lance') Graham was setting up the Australian Radio College (ARC) and its associated companies based in Broadway, Sydney.

Knowing that their success would depend on customised tuitional documents and on prompt personal replies to correspondents, the ARC office was planned around the use of dictaphones — essentially Edison style recording and playback machines, with electric motors and 'Pause' and 'Repeat' buttons. Lecturers would talk into them and typists could transcribe their words into printed form.

Technology re-applied

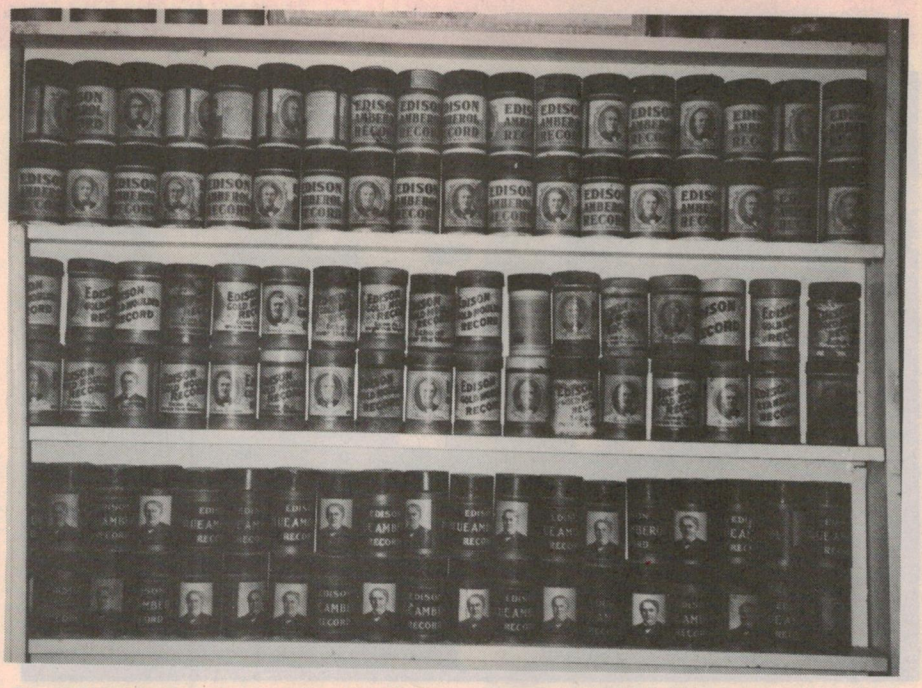
Dictaphones used special cylinders with a generous wax-like coating, soft enough to be impressed with a groove modulated by the sound of a normal voice through a speaking tube. Yet they were durable enough to reproduce the voice through a stethoscope tube, a sufficient number of times to allow a typist to type and double-check the content.

After completion, the cylinder could be run through a machine which would 'shave' and smooth the surface ready for re-use.

A former confrere Philip Watson, who worked in the ARC office at the time, told me that the machines were very reliable, economical and convenient to use, and remained in service long after equivalent Edison players had been superseded in the entertainment market.

So if you were once a student of the Australian Radio College, the chances are that some of the notes and reports that landed on your table started out as wiggles in wax — dictated and recorded mechanically by courtesy of Mr Edison...

If Edison's phonographs rendered the music box obsolete, traditional disc-based gramophones played an even greater role in bringing about a complete social revolution. That at least is the message that comes through in a visit to the Old Time Music Machine display.



One of several racks containing Edison cylinders. They were probably part of a music lover's prized collection from around the turn of the century.

The original phonograph, I gather, was conceived by Edison as a communication device to complement the telegraph and telephone. It certainly looked like a 'machine', and Edison is said to have had reservations about its promotion as a medium for entertainment.

By contrast, the disc system lent itself to economical mass production of entertainment recordings, to double-sided pressings, simple packaging, storage and handling. Marketing and the patent situation were more flexible and disc gramophones brought a wide variety of over-the-counter entertainment into otherwise silent homes around the developed world.

Memories triggered

Families would save up for a gramophone and gradually build a collection of favourite discs. They would play them when they felt so inclined, invite friends over for a musical evening, and share impromptu dance routines down the hallway.

As a lad, I recall that my grandfather owned the garage at Bargo on the southern highlands, and repaired or replaced broken gramophone springs as a useful sideline. Householders were routinely warned never to fiddle with the things, in case the spring 'let go'!

For a time my parents also ran a small music agency dealing in players, records, needles and sheet music featuring popular titles.

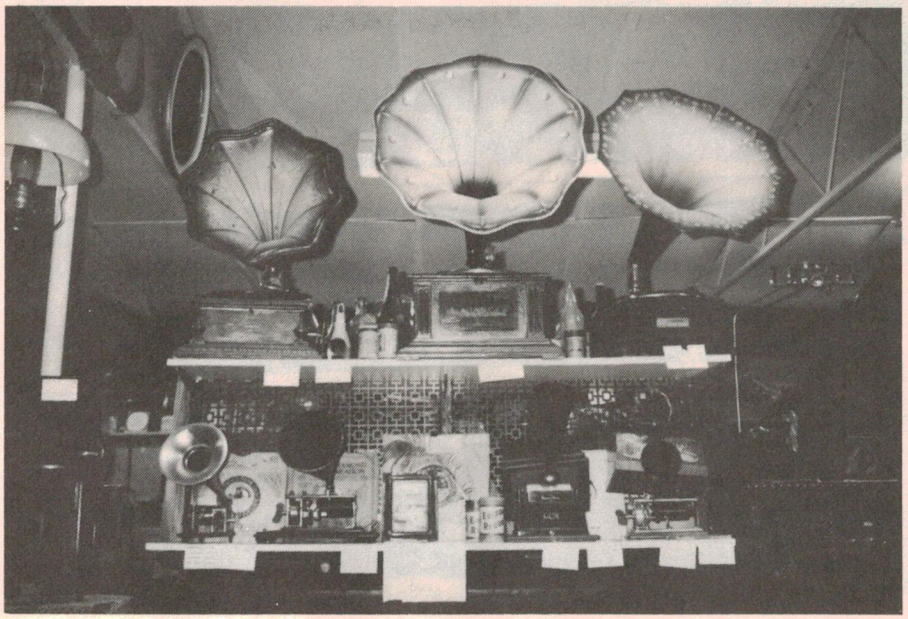
As reflected on the Neels' display, the majority of family gramophones were modest spring-driven table models, fitted with external 8" to 10" (20 to 26cm) diameter horns.

You were supposed to change the needle before playing each new side; in practice, each new record was nearer the mark!

On the shelves, the jumble of players, horns and handles, the casual scattering of Regal-Zonophone '78s (traditionally 2/6d each) and the background of old promotional leaflets shuffled the calendar back 60 years or more...

Gramophone horns in the 20s and 30s often tended to be rather vulnerable, but one I noticed in the Neels' collection was deliberately collapsible. In my school days, I had a collapsible drinking mug involving three or four tapered aluminum rings. Extended, they sealed one against the other to form a mug about the size of a teacup. Collapsed, they would fit into my shirt pocket.

The same principle was used to provide an acoustic horn for the portable disc player mentioned earlier. Expanded, six or more tapered aluminium rings became a make-do horn to 'amplify' the sound; collapsed, they folded down out of the way.



Surmounting a rack of vintage oddments are three table-top players with eye catching horns sprayed (l to r) green, blue and pink. Large, smoothly tapered horns 'couple' the vibrations of the diaphragm more efficiently into the air in the listening room.

Colourful sound

By contrast, three table models were on display with full-size horns that had been professionally sprayed to attract attention and emphasise their conical shape. One was finished in an olive green shade, one in mid blue and the third a delicate pink. Kevin said that vendors could arrange for horns to be sprayed before delivery, for a few extra 'quid'!

As distinct from metal horns some gramophones had built-in 'horns', which usually meant that the tone arm fed the sound down through the motor board and out through a fret in the front of the cabinet. It was a tidy arrangement, but there was scope for argument as to whether the sound was as clear and as loud as through a proper horn!

One player that did catch my attention was said by Kevin to have been especially popular for demonstrating records in a showroom. A cross between a table and a floor model, it had a wooden cube-like body, with the bottom corners extended to form 'legs'.

The turntable and tone arm sat on the top of the cube — just — protected by a lift-up lid carrying the name (I think) 'Homophone'.

There was a fret of sorts on the front, but whether the sound emitted from this or from underneath, or both, I am not sure.

Kevin assured me that there was nothing special about the particular disc but for whatever reason, the 'whatever-it-was' seemed acoustically more efficient — and louder — than usual!

Kevin observed that the museum did not contain many examples of floor model console gramophones. They had been relatively expensive, and people had tended to adapt the often handsome cabinets for other purposes rather than discard them. They took up floor space in a museum, which was a further consideration.

'Yer gotta larf!'

Incidentally, one of the gramophones was fitted with a novelty which I had read about but, I doubt, actually seen before — a novelty dancing man. One end of a sprung platform was anchored to the motor board; the other end could be clipped over the turntable spindle. As the turntable rotated, the platform was jiggled up and down.

Supported on the platform was/is a clown-like figure with loose, dangling arms and legs which vibrate, such that the clown appears to be performing a tap dance.

Kevin said that it's always good for a laugh in the museum, particularly if he chose a record where the music happened to be 'in sync' with the antics of the dancer...

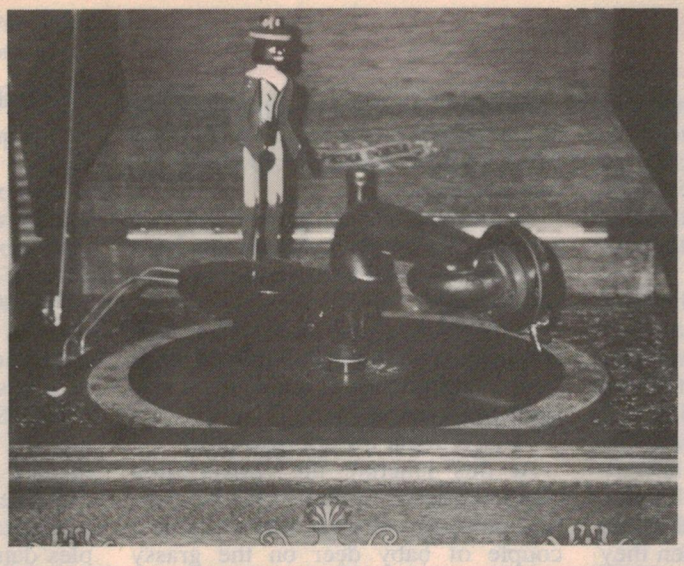
As a variation from the above, he has another player fitted with two clowns on the platform, dressed as pugilists. Sometimes they merely appear to threaten one another; at other times they clash in a frenzy of arms and legs. Again, it's good for a laugh.

Sundry radio receivers from the 20s and 30s, which have been donated to the museum. Kevin professes to know nothing about radio, as much as anything because it did not feature in his family life as a 'bush kid'.

Rounding off the display are a couple of old-time juke boxes, intended for use in clubs and amusement parlours and accommodating a dozen or so hits on standard 10-inch 78s. Both are still in working order, one being of historic interest in that it came from Sydney's original Luna Park, prior to the fire.

Other items on display include several radio receivers from the 20s and 30s. Kevin professes no special interest or expertise in old radio sets, the ones on show having been passed on to him by well-wishers.

The same applies to an early domestic 'Singer' sewing machine and various old-time tradesmen's tools which have found their way onto the shelves. They serve a purpose if a visitor is heard to exclaim: "I used one exactly like that!"



Affected by the rotating spindle, a sprung platform vibrates and causes this diminutive clown to perform a tap dance.

How it came about

It was at about that stage in our tour of inspection that Dawn Neels suggested that we might like to head for a cup of tea on the verandah. She explained that they could cope with light refreshments and barbecues, but were not licenced to function as a restaurant. More to the the point, as far as I was concerned, was that a tea break would give me the opportunity to ask Kevin a few biographical questions for this article.

Both his grandfather and father, it appears, had been 'homesteaders', his grandfather having taken up a small property and built a slab house at a place called Koorawatha in the Lachlan Valley, NSW. He himself had been born in the formality of Goulburn Hospital but the rest of his boyhood, other than those first few days, had been spent in the pioneer style family home.

Merely earning a living took up so much of his father's time that Kevin, as the eldest of five children, had to chop the wood and do much of the 'man's work' around the home. The favourite meal in the Neels' household was rabbit, with Kevin once again being the chief provider. Quote: "I was a typical bush kid!"

Around 1941, the family moved to the Southern Highlands area, then on to Kiama on the coast and later to Windang near Lake Illawarra.

Meanwhile, his father was working in the steelworks at Port Kembla, at a job which was said to have demanded 'Superman' qualities. In the so called 'hot mill' the men had to guide red hot steel bars, with tongs, to and through rollers until they conformed to the required dimensions. This was on the basis of 20 minutes on, and 40 minutes off! It was work that Kevin himself could not cope with.

An 'impossible' dream

Details aside, the changes in lifestyle explain how, complete with ferrets, he came to be snaring rabbits on the road leading from the Highlands to the Macquarie Pass — thence down the mountainside to the coast. This was in an old Chev car.

On a day that lingers in his memory, the ferrets stayed down the rabbit warren and, unwilling to 'dig them out', Kevin sat on a rock and waited for them to show. It was then that he noticed the magnificent view, and formed a seemingly impossible resolution: "If ever I get around to building my own house, it will be on this very rock!"

Years later, a 'For Sale' notice

appeared on the land and inquiries turned up a seemingly impossible proposition (for Kevin), based on 'quick sale' by the end of the week. But 'somehow' he managed to raise a loan and commit himself to paying it off...

When the time came to build a house, it was painfully clear that Kevin would have to organise most of the work himself. An architect friend helped sort out the formalities, and a couple of 'brickie' mates laid the foundations and showed him how to proceed. The project grew 'a bit like Topsy', with bits added and ideas incorporated as they could, when they could and in spite of the sometimes high winds over the crest.

"And where was Dawn all this time", I asked, "facing the debt and giving expression to your dream?"

Said Kevin: "She backed me all the way. Sure, I had to work hard but every time I looked up, she'd be right there behind me doing her share!"

To Dawn, my question: "How did you feel about Kevin's obsession with old gramophones and old records?"

Dawn: "I shared his interest. I loved the old music. My one reservation: I didn't want the stuff in the house — stacked in cupboards and under beds!"

A '£2' gramophone

That led naturally to a key question, addressed to Kevin: "Tell me, how did a bush boy like Kevin become involved in gramophones in the first place?"

Kevin: "I first heard a gramophone at a neighbour's place, as a kid. I told Mum about it and pestered her to get one ourselves."

"Mum managed to get one for two pounds. She bought it for me and I got it going. We used to listen to it at night before bed!"

"You mean to say that this whole set-up originated from a two-quid gramophone and a few scratchy records?"

"That's about the strength of it!"

At this juncture the conversation was interrupted by one of the womenfolk pointing out what seemed to be a couple of baby deer on the grassy slope below the window — aren't they sweet! Luvverly!

Kevin explained that they would have been born about a fortnight ago and that "the oldies usually hide them for a couple of weeks after birth".

"There's quite a menagerie down there attracted by the food I leave around the place: an old-man peacock, kangaroos, pheasants, guinea fowls, quail, geese, turkeys , ordinary chooks and New Zealand rabbits — they're a distinct strain, a bit bigger than the Australian bush bunny. Years ago, I'd have shot them but, these days, I prefer to sit here and drink my tea and watch them hopping around!"

As if on cue, a mountain lowry or king parrot chose that moment to land in the shrubbery outside the window — a magnificent bird, somewhat sleeker than a crested galah but with a magnificent golden-yellow head and neck merging into a multi-coloured body and wings.

Re-living the past

One question remained as I pondered all this: "Tell me Kevin: I can understand a bus load of senior citizens enjoying the outing, the refreshments and the view, but what do the womenfolk make of the gadgetry in the museum?"

Said Kevin: "We've been entertaining bus loads of senior citizens at a professional level for the past couple of years, mainly church groups and PROBIS Clubs. I often welcome them into the Museum by turning on one of the old gramophones loaded with an old time favourite record."

"Next thing I'll see two or three couples dancing down the aisles, spontaneously re-living the past.Again, they sometimes wheel in aged folk who probably don't know where they are. At the sound of the music, you see their heads come up and they'll start nodding to the tempo. I know then that the sound has penetrated the mist of lost years."

'Bush Boy', 'Bush Girl'? I liked Kevin and Dawn Neels, and commend their attitude and enthusiasm.

The one thing I didn't share was their enthusiasm for an impressive old Juke box in their lounge room, rescued from the Pub/Club at Sussex Inlet on the NSW South Coast. Old Time Music Machines are fascinating to revisit, but how fulfilling the sound may be is another matter!

FOOTNOTE: 'Old Time Music Machines' is situated at Lot 1, Illawarra Highway, Robertson NSW 2577; phone (048) 851 562. ❖

PARKES PREPARES FOR GALILEO'S CALL

Continued from page 19

Despite all this added mass, the Parkes dish still maintains a near-perfect surface curvature, with an RMS error less than 0.4mm over the entire 64-metre diameter, and less than 0.2mm over the central 44-metre section.

Three cranes needed

Putting all this together has been a major achievement for Australian industry. Structural engineering company Connell Wagner of Sydney did the design work, and prime-contractor Evans Deakin Engineering of Brisbane carried out the construction task. In order to lift the cabin into position — 40 metres from the side of the dish and 60 metres above the ground — three cranes were used. But not the way you might first think.

A 50-tonne mobile crane arrived early during the operation to help with the construction of a 120-tonne crane. This crane was used to lift the scaffolding components into the dish. The scaffolding supported the tripod legs during the upgrade.

The 120-tonne crane was then used to help build a 400-tonne crane, which was finally used to lift the new cabin into place. While the cabin doesn't weigh 400 tonnes, it did have to be manoeuvred into place 60 metres above the ground and 40 metres from the edge of the dish, with an accuracy of a few millimetres!

Once the renovations are completed, NASA will rent the Parkes telescope for 13 months beginning in November 1996. For 10 hours a day, the dish will be pointed at Jupiter, listening intently for the feeble but valuable signals from Galileo's 2.3GHz antenna.

The data will be sent directly to Tidbinbilla via optical fibre, where they will be combined with the signals from the other dishes.

Then a decoded signal will be simultaneously recorded on tape and transmitted to the Galileo Mission Control Centre at the Jet Propulsion Laboratory in California. Long after the Galileo mission is over, however, Australian astronomers will have access to a radio telescope that's as versatile and sophisticated as any in the world.

(Geoff McNamara is a freelance astronomy writer and Associate Editor for Sky & Space magazine.) ❖

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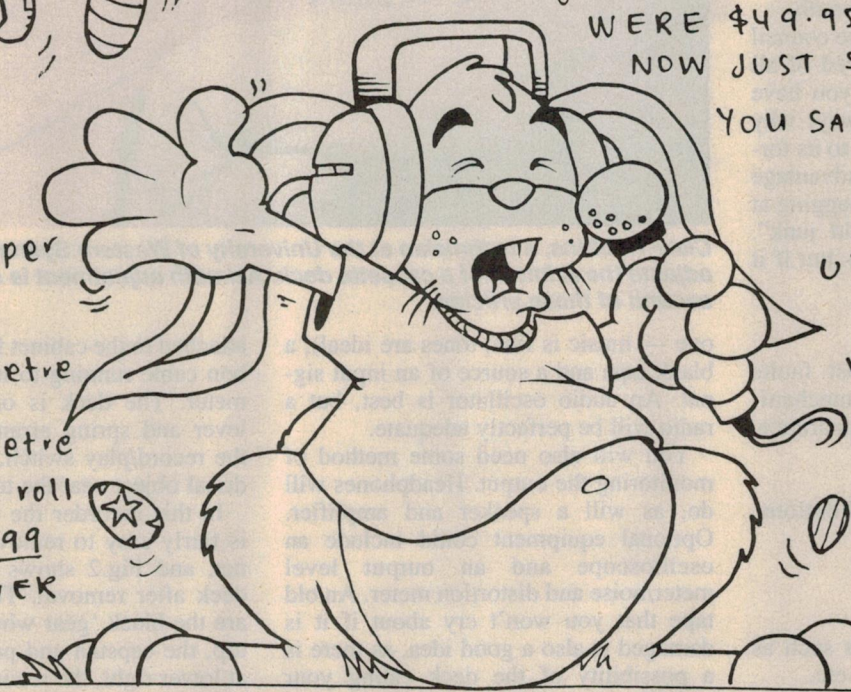

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READER INFO NO. 4

REPAIRING CASSETTE TAPE DECKS - 1

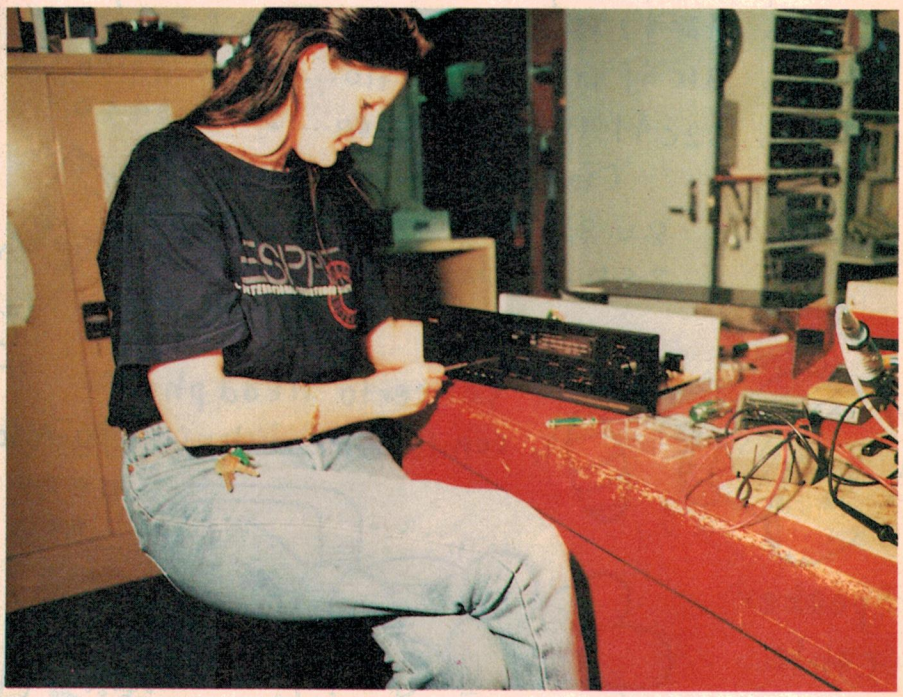
When cassette tape decks give trouble, generally no-one wants to know them. They often get thrown out in the council clean-up, given away for spare parts — or simply left to gather dust in a cupboard. But cassette decks *can* be repaired and made to work like new, often without spending too much money. Here's the first of two articles explaining how to bring them in from the cold...

by BRYCE TEMPLETON

If you are an amateur enthusiast, or even a professional technician, you probably have an old audio cassette deck that has been given to you with the words "You might as well have this, it's not worth repairing, the heads have gone. You can use it for spares". What spares? What can you get out of a 10 year old cassette deck? And even if you *could* find something of value, who would want their deck repaired with second-hand 10 year old parts?

But I rave uncontrollably. There are some parts that can now only come from old machines — knobs, buttons and cabinet parts to name a few, so we should not look a gift cassette in the mouth.

Maybe you found one in those council clean-ups that are much beloved of all true technicians; in this case you have only yourself to blame. Anyway, why not try to repair it and restore it to its former glory? This also has the advantage of stopping your wife/mother nagging at you to throw out "all that old junk". Some women have no heart — but if it works, she'll probably use it.



Clare Robbins, a technician at the University of Western Sydney in Kingswood, adjusts the azimuth of a cassette deck. Azimuth adjustment is discussed in the second of these articles.

Likely faults

OK, here's the drum. Most faults with audio cassette decks are mechanical. In order of most likely appearance, they are:

1. Belts
2. Operating controls, pushbuttons, switches etc.
3. Input and output connectors
4. Motors
5. Heads
6. Then come electronic faults such as transistors, IC's, capacitors, etc.

Have I talked you into it?

Well, what you will need is a set of hand tools with a soldering iron (make them small enough for the job — not harbour bridge size), a multimeter, cleaning materials (methylated spirit is fine for head and belt cleaning), a prerecorded tape (preferably a commercial one — music is fine, tones are ideal), a blank tape and a source of an input signal. An audio oscillator is best, but a radio will be perfectly adequate.

You will also need some method of monitoring the output. Headphones will do, as will a speaker and amplifier. Optional equipment could include an oscilloscope and an output level meter/noise and distortion meter. An old tape that you won't cry about if it is damaged is also a good idea, as there is a possibility of the deck eating your good Stones tape...

Know your deck

Before we get going, let's examine the parts of a typical deck.

Fig.1 shows a general view inside a deck. The amplifiers and other electronics are on the left, and the small board attached to the cabinet front with the ribbon cable running to it is the LED VU meter. The deck is on the right. The lever and spring arrangement operates the record/play switch, while the cylindrical object near the top is the motor.

In this recorder the deck mechanism is fairly easy to remove from the cabinet, and Fig.2 shows the front of the deck after removal. The spool carriers are the black 'gear wheels' towards the top, the capstan and pressure roller are at lower right, the record/play head is in the lower centre, and the erase head is black coloured and at the lower left. The back view (Fig.3) shows the motor at upper right, the black circular flywheel, and the belts.

Fig.4 shows at the right the capstan and pressure roller, also called the pinch wheel. In operation the tape is squeezed

between the capstan and pressure roller, and moved at a constant speed across the heads. Worn pinch wheels can cause tape damage by forcing the tape against the guides, or even completely out of the correct path. Note that when playing or recording, the tape direction is always such that it contacts the heads before it gets to the capstan; in other words the capstan is the last thing in the tape path.

The two heads, also shown in Fig.4, are mounted on a plate that slides them forward into the cassette when activated by the play button. The black head, on the left in the photo, is the erase head.

There are three types of erase heads. The most common is called an AC erase head, which is — surprise, surprise — supplied with a high frequency AC voltage, around 3-5 volts peak to peak at 50 - 100kHz. Less common and usually only used in 'el cheapo' machines are DC erase heads and permanent magnet erase heads. The latter are distinguishable as they are mechanically moved into contact with the tape when erasure is required.

AC erase heads are always used in any machine that has the slightest pretensions to 'hifi'. These are usually made from a ferrite material, and are extremely long wearing. As the gap is relatively non critical, it is most unusual for one to 'wear out'. If your deck is not erasing, check carefully elsewhere before replacing the erase head. There are not usually any adjustments on the erase head.

The silver head in the centre of Fig.4 is the record/play head. This is made of a hard wearing steel alloy, but will still wear out after prolonged use. The tape eventually wears through the pole pieces and the gap, which is normally so small as to be invisible, opens up. This will not greatly affect the record function, but the 'top end' play response will be greatly reduced.

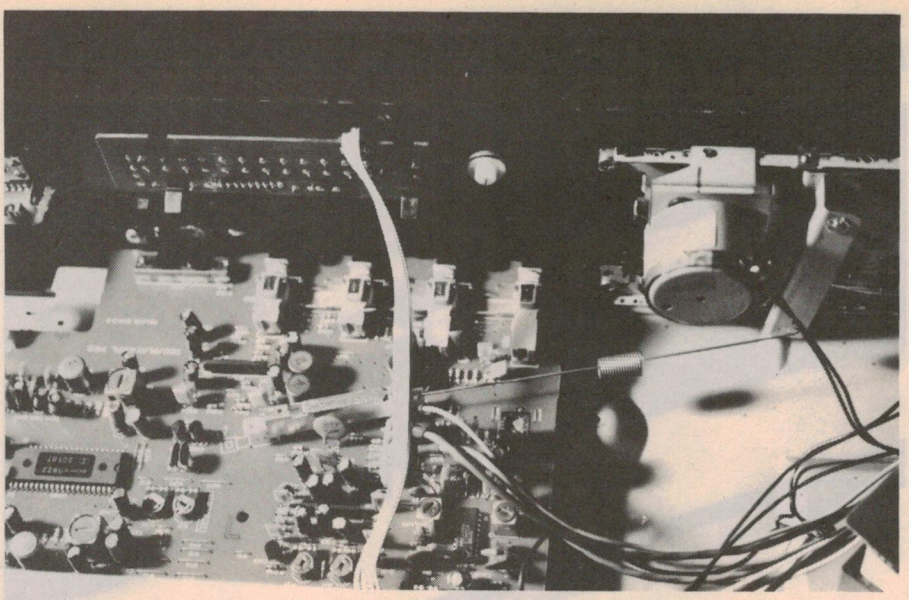


Fig.1: A general view of the interior of a typical cassette deck. Note the lever and spring connecting the transport to the Record/Play slider switch on the PCB.

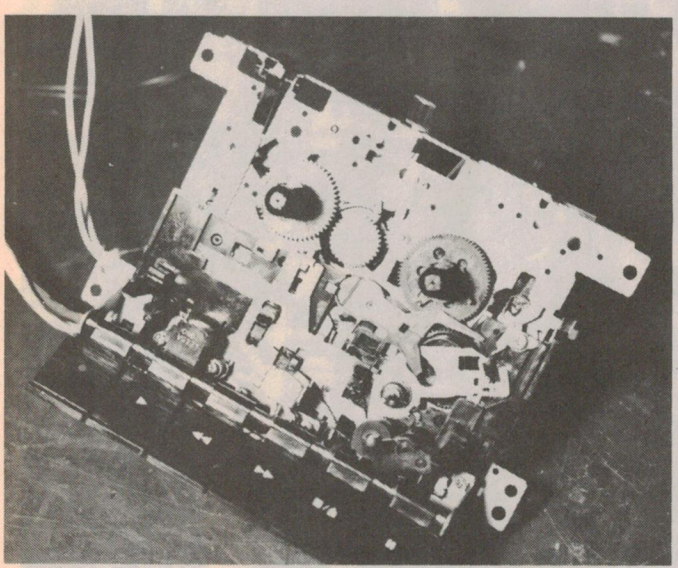
Starting repairs

Now we are more familiar with the main parts of our recorder, let's make it go!

The first step is inspection. It is not a good idea to clean too vigorously before checking the operation, in case the cleaning dislodges a belt or otherwise creates problems that weren't there before. One of the golden rules of servicing is never take something to bits before trying it out. There is a terrible sinking feeling that accompanies the realisation that you don't know if a fault was there before you cleaned it, or not!

Before plugging it in, carefully check the mains cord and plug. Operate the mains switch a few times to ensure that it is mechanically OK, then plug in and switch on. Hopefully we should get a few signs of life. A few lights or a slight movement of the VU meters is encouraging.

Push the Play button and see if the heads and pressure roller move to the



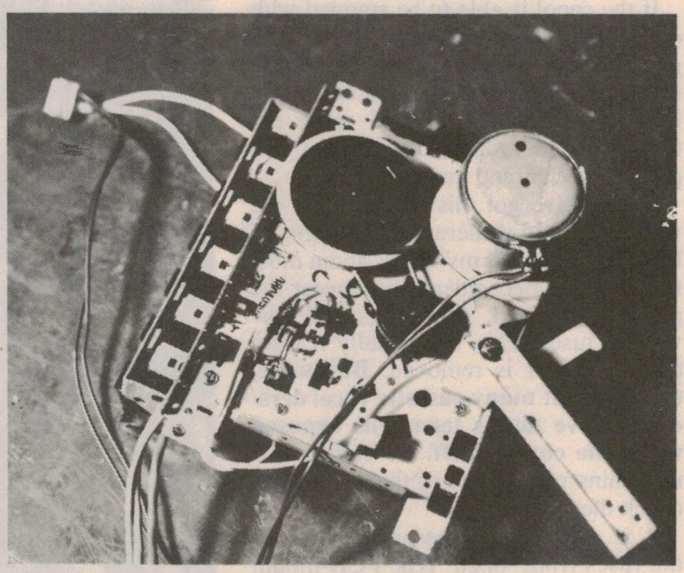


Fig.2 (left): A front view of the deck when removed from the case. The actuator buttons are along the bottom edge. Fig.3 (right): The rear of the deck when removed from the case. The drive motor is at upper right, with the capstan flywheel to its left.

REPAIRING CASSETTE TAPE DECKS - 1

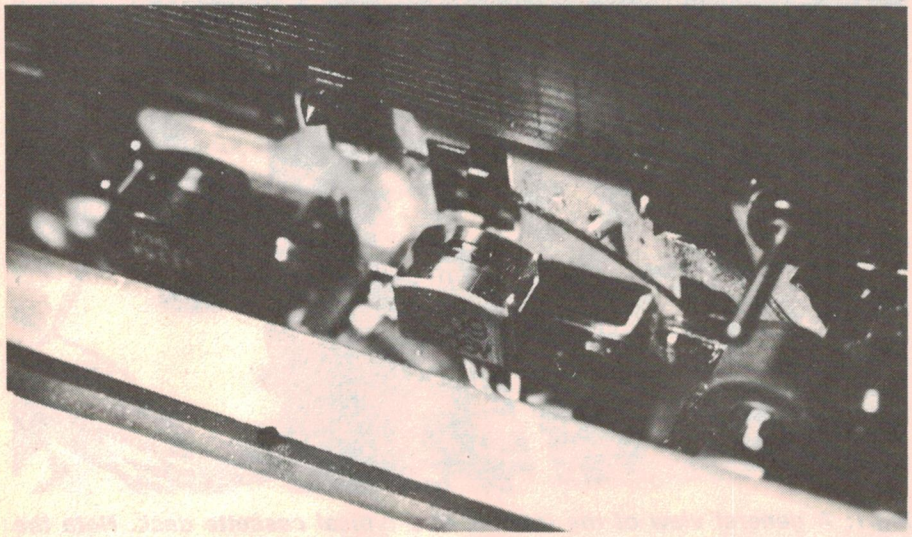


Fig.4: A close-up view of the heads (centre and left) and the capstan and rubber pressure roller (right).

replay position, and the capstan and take up spool carriers rotate. Usually you can operate the play button with the cassette door open, but some decks do require it to be closed — some even know if there is a tape inside.

Try the rewind and fast forward buttons, to see if the appropriate action happens. Note that many decks with auto stop will run in fast forward only for a few seconds without tape, as the 'auto stop' circuitry senses that the take-up spool is not rotating. Go back to the play function and stop the take-up spool carrier rotating with your fingers; there should be reasonable tension.

If the spool is able to be stopped with only slight finger pressure, there is a good possibility that the tension will be insufficient to take up the tape as it is fed from the capstan. This will cause the tape to wind around the capstan and pressure roller, and you will curse...

If you have got this far, then we are well away. But if there were no signs of life, then delete all my words about most faults being mechanical, disconnect the power and check the mains and low voltage fuses. This will usually require that the cover is removed. **Be aware, though, that many cassette recorders/decks have mains terminals exposed when the cover is off.** Be certain that the mains plug is out of the socket and check the fuses.

It is often not necessary to remove the fuses from 'open' type PCB-mount fuseholders to check them, using a multimeter on the low ohms range. They should, of course read less than one ohm. If you find a dud, replace it ONLY with one of the same rating, size, and delay.

Fast acting fuses have the rating indicated as, for instance 1A/250V. Delay fuses show it as T1A/250V, the T indicating thermal. These fuses also often, but not always, have a 'blob' or a small spring visible on the wire inside the glass.

Having replaced any blown fuses, plug in and switch on. If it now works, cheer softly. But if it blows again, power supply fault finding is in order. If the mains fuse keeps blowing, seek the advice of an experienced technician, as repairs in this area can be hazardous. If it is the low voltage DC fuse, you may be able to isolate the problem by removing plugs connecting the deck with the PC board, and trying again. This approach can become a bit expensive though, as each fuse costs about 50 cents. This sort of difficulty can be caused by stalled motors, shorted electrolytic capacitors, the record/play switch broken or stuck in a 'half-way' position, or shorted IC's, diodes or transistors.

Vital life signs

Taking the happier view, if we now have a deck that lights up, and on which the wheels turn, we should check out the electronics. Do this by connecting your signal source (the oscillator or the radio) to the cassette deck inputs and monitor the outputs with your amplifier and speakers or headphones.

Now some cassette recorders will immediately burst forth with glorious music, but some you will have to set into the record mode.

Place your 'don't care' cassette into the deck and press the Record button only. If the tape starts moving, press the Pause button. This should result in music (or tone) emerging from the output, and an indication on the recording level indicators, whether they be VU meters, LED indicators or flashing lights.

Some up-market recorders have a

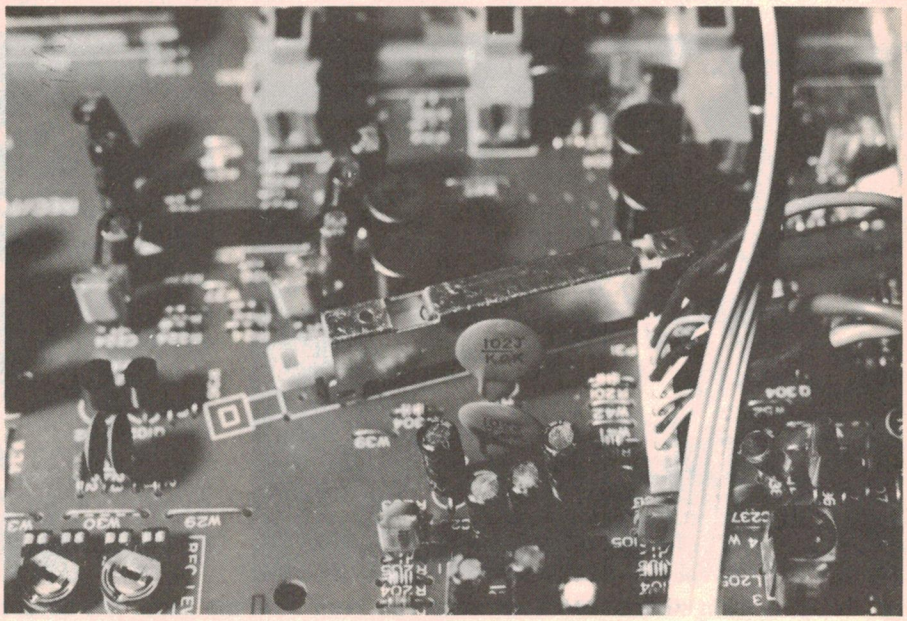


Fig.5: A closer view of the Record/Play switch, on the main PCB. The actuator spring from the transport hooks into the rectangular hole in the white plastic slider, visible at the left hand end.

switch to allow you to choose between 'Input' (what is going *into* the recorder) or 'Tape' (what is being played back off the tape). For our test, set it to Input. With these decks it is not necessary to select record or even have a tape in the deck.

Note that it is desirable to fed both inputs of the recorder simultaneously with your test signal, and that may require a 'Y' cord or adaptor. Do not however, Y cord the outputs; these should be monitored individually.

This test will check that almost all the electronics is operating. The only parts left untested are the head pre-amps and the bias oscillator.

If there is no joy, a common fault with decks that have not been used for some time, or that are never used to actually record cassettes, only to play them back, is the record/play switch. This is generally a long slide switch, normally near the middle of the board, and usually operated by a lever or spring from the deck (see Fig.5). A good clean-out with a quality contact cleaner (do *NOT* use an oily cleaner such as WD40) and a vigorous workout will most often restore normal operation, but if the problem returns, the only lasting solution is to replace the switch.

A good tip when working with the R/P switch, or with the deck disconnected from the switch, is to make sure that the switch is in the 'play' position before putting your favourite Stones tape into the deck. If the linkage is disconnected, the electronics can be in the 'record' mode even though the button is not pressed. This of course will result in the erasure for all time of Mick and his mates...

If we are happy so far, it is time to check out the transport. Place your 'don't care' cassette into the deck and select play. Keep a careful eye on the two spool carriers, especially the take-up one — they should rotate smoothly and continuously, and should not hesitate or stop.

If erratic performance is noted, the problem is frequently the belt that transfers the drive to the spool carrier. To test, remove the cassette, place the deck into play mode and observe the wheel at the rear of the deck that the spooling belt drives, normally in the vicinity of the spools.

Even with the spool carrier stopped 'by finger', the belt must continue to turn the lower side of the spooling clutch. If it stalls, replace the belt. Actually I would replace ALL the belts and the pressure roller as a matter of course, as they cost only a few dollars, and cannot be rejuvenated successfully.

Replacement of the main drive belt, and sometimes others, often requires that the capstan assembly be partially dismantled. Carefully note the order of removal of the parts, and do not lose the small washers and circlips. Do a sketch if you are in any doubt. Nothing is worse than seeing a washer on the bench that should have gone on first, as you tighten up the last bolt! Take the opportunity to place a very small amount of fine oil on the capstan bearing — but try not to get any on the capstan spindle where it contacts the tape.

How do you determine the correct size belt? Simply fold it in half and measure the length, double this and you have the total length.

The parts dealers are able to cross reference this into the diameter. Choose the next smallest size, as the old belt will have stretched. They are available in square section sizes of 0.8x0.8mm, 1.0x1.0mm, 1.2x1.2mm and 1.4x1.4mm. Flat section belts are also available.

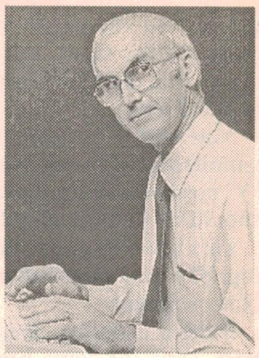
The dimensions required to order a pressure roller are shaft diameter x wheel diameter x by overall height.

In the second of these articles, we'll move on to explain how to check and adjust the deck's performance.

(To be continued.) ❖

FORUM

Conducted by Jim Rowe



Microcontroller-based projects: readers hop in for their say...

You may recall that in the January issue, we opened up the rather thorny subject of whether or not magazines like *EA* should run more microcontroller-based projects — and when we *do* run them, whether or not we should also publish the full source code. Perhaps it's no surprise that there's been quite a flood of responses to this one from readers, many of them making quite thought-provoking points. I'm presenting a good selection here, for your interest.

As I wrote when I was introducing the subject in the January column, it's one that I've been chewing over myself for some time, and from the letters and faxes I'd already received it seemed to have been exercising the minds of quite a few other people as well. So the fact that it has produced a 'healthy' response really isn't surprising — especially as it involves one of the important roles of a magazine like *EA*: helping our readers get on top of emerging technology.

Anyway, there has certainly been quite a big response, and many of the people concerned have made very valid and thought-provoking points. So without further ado, I'll present them for your consideration.

The first one comes from Mr Peter Barnett, of Lindfield in NSW, who sent the following response to our BBS within a day or two of the issue being published:

I found the discussion in Forum on the problems associated with microcontrollers very interesting. The issue of source code for a project is a vexing one; without access to source code most microcontroller projects have little value beyond the inherent value of the device being constructed — i.e., there is generally no real educational value in the project.

As a professional programmer myself, I understand the time involved in any software project and also the perceived value of that software, especially by the designer/programmer.

What I find frustrating with microcontroller-based projects is not so much the general lack of access to the complete source code, but the lack of access to the parts of the source code that do the 'interesting' work. Most microcontroller-based projects have at least one function which makes them interesting; it may be something like the handling of an external ADC on a low-end microcontroller, or interfacing with a time-critical device like an LCD, an EEPROM or a DS1820 temperature sensor. It is these 'interesting' functions that I would like to examine the code for, to see how the programmer solved the problem.

Also, a few projects would go from being 'interesting' to being truly useful, if source code was available. An example of this might be a monitoring device which displays its inputs on an LCD, but would be useful to me if the output was RS-232 which I could send to a desktop computer, so I could manipulate that output in some way not considered by the designer — perhaps by timestamping it and later loading it into a spreadsheet to graph and observe trends.

With the source code, such changes may be justified in terms of time spent versus benefits received, in which case I will buy the kit and make the modifications. Without the source code or the willingness of the designer to a one-off modification just for me, I go on to the next article and do not buy the kit.

I suggest that in a microcontroller-based project the source code should be considered an important optional extra, and should be made available in the same way as the PCB. In projects where the copyright is retained on the PCB artwork, the PCB can still be bought at a reasonable price. Copyright is always retained on software, unless the owner of that software places it in the public domain.

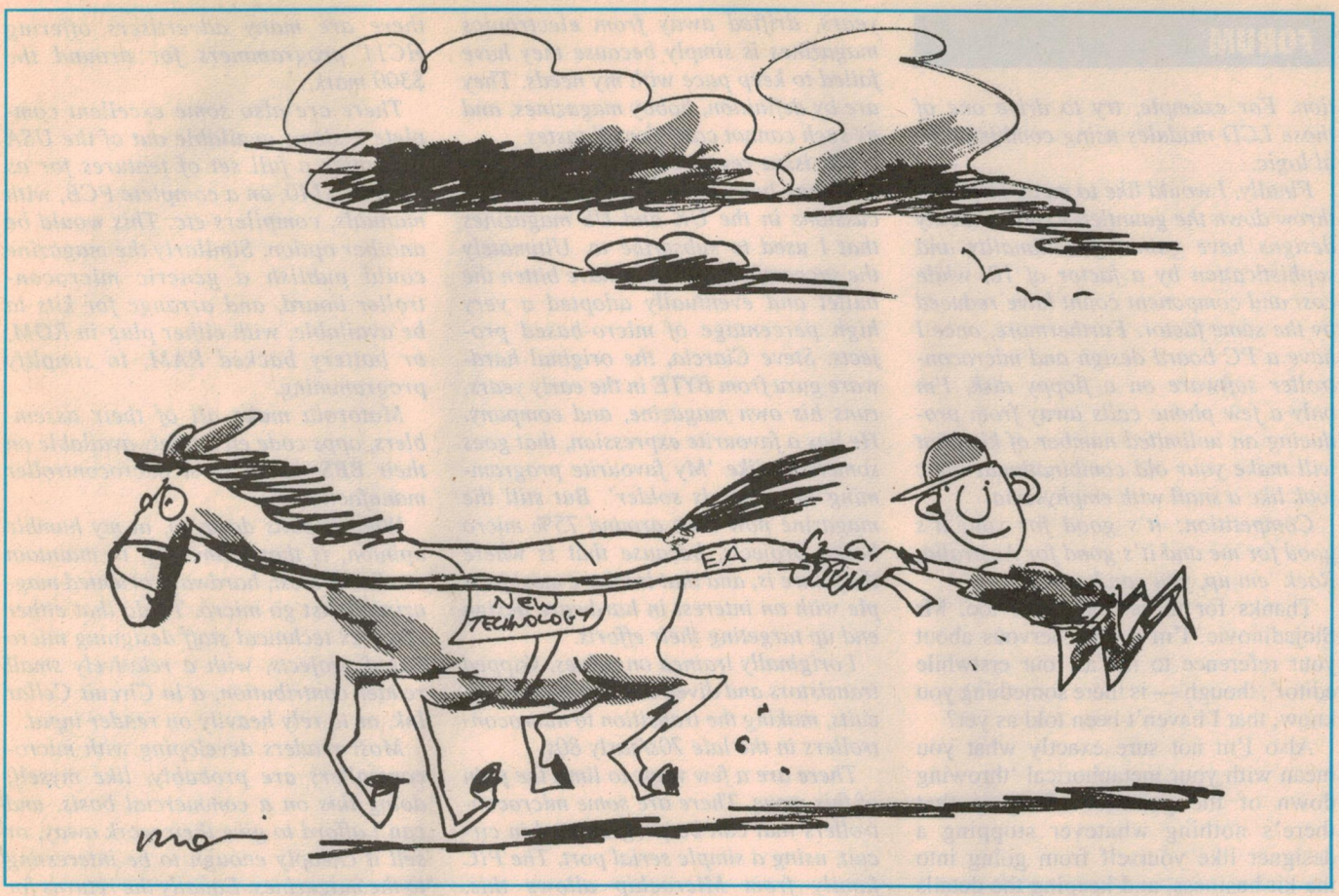
Why do the designers of microcontroller-based projects not want to sell copies of the source code and make a little extra money for their troubles? Do they truly believe that I will immediately copy their design and sell millions to a world eagerly awaiting the latest thing in garden watering controllers? Yes, they do (remember, I'm a programmer).

It seems interesting to note that this possessiveness with source code for what are, really, commercially non-viable projects seems to be a phenomenon which only affects Australian and New Zealand programmers. All American and English magazines that I read make the source code for projects available as a matter of course.

I have a CD-ROM which contains the full text and source code for all articles in 'Embedded Systems Programming' magazine from its inception to the December 1994 issue, which cost US$50. I can download the source code for every microcontroller project ever published in 'Circuit Cellar INK', and I can visit the Motorola Internet site and download multiple megabytes of code for their microcontrollers — all at no cost, and with their blessing.

So, what is the answer to the question of microcontroller-based projects and their source code? Perhaps EA could let project designers know that any microcontroller-based project presented which does not allow readers access to source code, or at least those parts of the source code that make the project worthy of publication will be considered incomplete, in the same way that a project where the PCB is not available is incomplete — and will only be considered for publication once the supply of 'complete' projects have been exhausted. Whether this would have any effect would depend on the backlog of projects EA has awaiting publication.

Perhaps we should remember that the project designer/programmer owns



the software and can do with it what he or she chooses. We should also remember that readers of EA have an expectation about the usefulness of projects presented in the magazine. An incomplete project is little more than a free advertisment for the organisation selling the project.

Hmmm — thank you for those comments, Mr Barnett, and you've certainly made some very relevant points — largely in favour of us publishing the projects complete with firmware source code, or at the very least the 'interesting bits'.

But moving on, another interesting response came from Mr Nenad Stojadinovic, of Woden in the ACT. Here's what Mr Stojadinovic had to say, again in a message left on the BBS:

I read with interest the discussion about microcontroller software and felt the need to throw my two cents in.

I guess it is inevitable that any powerful new technology should bring with it a commensurate set of problems. In this case it seems to me that really we are spoiled for choice, and there will never be any one universal solution; the idea being to negotiate one that works for you.

You didn't name it specifically, but your January discussion was really all about the application of intellectual property, and consequently you should be seeking advice from an attorney that specialises in the field. However, I thought I could put up one or two examples from this (vast) area of law to spark some discussion.

If you invent a clever piece of software and you want to keep it to yourself, then that is called an industrial secret. People will buy your invention and use it in the same way as they drink Coca Cola® without knowing the formula, or use Windows 95® without the source code.

The problem is that kit manufacturers will be reluctant, because a bag of components and a PC board without a major chip goes by a special name: scrap. Perhaps our erstwhile editor may still want it as an article at a price you like, but if not, he will most certainly want it as a classified ad. Congratulations you are now a kit manufacturer, and you're looking for a good deal on commercially made PC boards for your kit.

If that doesn't suit, then you will need to licence the software to a manufacturer, perhaps as a condition of sale to the magazine. For example, you may negotiate that you are paid in the usual way for the article and any manufacturer that wants a copy of the code gets it for free, and in confidence.

Yes, that means all the manufacturers will need to have programming facilities, but I don't think that they'll have much choice if they want to remain competitive.

So what about educating the readers if the code isn't published in either case? Well, education is time dependent. In these early days there is a need for teaching articles and simple projects where the code is available; something that is already occurring.

In the future, however, anyone interested will have enough information to approach a particular chip manufacturer for their information. I learned to program PICs from the Microchip® applications handbooks, and programming books are already appearing as they did for the Z80 and 6800.

I would like to disagree with the assertion that microcontroller projects are more difficult to develop. Surely if that were true we wouldn't be bothering? Once you've got the hang of it, it's simply a matter of plugging together subroutines.

Perhaps you are confusing it with the fact that microcontrollers allow previously unheard of levels of sophistica-

tion. For example, try to drive one of those LCD modules using combinational logic.

Finally, I would like to metaphorically throw down the gauntlet. I know that my designs have gained functionality and sophistication by a factor of 10, while cost and component count have reduced by the same factor. Furthermore, once I have a PC board design and microcontroller software on a floppy disk, I'm only a few phone calls away from producing an unlimited number of kits that will make your old combinational logic look like a snail with emphysema.

Competition; it's good for you, it's good for me and it's good for Australia. Rack 'em up, you can break...

Thanks for those comments too, Mr Stojadinovic. I'm a little nervous about your reference to me as 'our erstwhile editor', though — is there something you know, that I haven't been told as yet?

Also I'm not sure exactly what you mean with your metaphorical 'throwing down of the gauntlet'. I agree that there's nothing whatever stopping a designer like yourself from going into the kit business, and keeping the details of your designs a trade secret. But we weren't even attempting to challenge this; we were merely seeking to explain the complications of publishing micro-based projects in magazines like EA.

Need for learning

I guess the only possible criticism that *readers* might wish to make, about designers keeping their work secret and selling kits themselves, is that the rest of us won't learn much from this. And for many people, much of the motivation for building up electronic kits is to get 'hands on' learning experience.

I agree, though, that this need not be a problem for designers like yourself wanting to get into the kit business. If your design is good enough, presumably you'll still sell lots of kits.

Moving on again, our next response came from Mr Alan Cook, who didn't offer his address when he left the following message on the BBS:

I was interested to read of your agonising over this decision, in January's issue. I have to be honest and admit that I am not a regular reader, normally purchasing electronics magazines for single items of specific interest, or for projects for my kids.

The main reason that I have, over the years, drifted away from electronics magazines is simply because they have failed to keep pace with my needs. They are by definition, hobby magazines, and as such cannot cater for all tastes.

The issue regarding micro-based projects has been through these same discussions in the UK and US magazines that I used to subscribe to. Ultimately the successful magazines have bitten the bullet and eventually adopted a very high percentage of micro-based projects. Steve Ciarcia, the original hardware guru from BYTE in the early years, runs his own magazine, and company. He has a favourite expression, that goes something like 'My favourite programming language is solder'. But still the magazine now runs around 75% micro based projects, because that is where the future is, and that is where most people with an interest in hardware design end up targeting their efforts.

I originally trained on valves, skipped transistors and dived into integrated circuits, making the transition to microcontrollers in the late 70s/early 80s.

There are a few ways to limit the pain of this move. There are some microcontrollers that can be programmed in circuit, using a simple serial port. The PIC family from Microchip allows this. There is also a variant available, which is programmable in Basic, called the Basic Stamp. These are inexpensive microcontrollers, and, even in small numbers are quite affordable.

There is also the Motorola HC11 family, which has been around for some time, but which few people seem to realise has in-system programmability, to a degree. The HC11 can be started in 'bootstrap' mode, which enables a small program to be downloaded, via a PC, to the HC11. This could be an executable program, run from RAM, which is obviously limited in scope; but it could also be a full fledged program to reside in either on-board ROM, or external ROM, providing that the necessary ROM programming voltages are available.

Another possibility, which I use in a commercial design, is to use a high speed EEROM in place of the ROM. This permits in-system reprogramming from a remote location, without the pain of handling bulk-erase Flash EPROM.

A simple programmer for the PIC family is only about $250, and it comes with compilers, software simulators and a full set of technical and application manuals. Hartech and Zatek handle Microchip. Motorola have no cheap programming options themselves, but there are many advertisers offering HC11 programmers for around the $300 mark.

There are also some excellent complete systems available out of the USA that offer a full set of features for as little as $140, on a complete PCB, with manuals, compilers etc. This would be another option. Similarly the magazine could publish a generic microcontroller board, and arrange for kits to be available, with either plug-in ROM, or battery backed RAM, to simplify programming.

Motorola make all of their assemblers, apps code etc., freely available on their BBS, as do most microcontroller manufacturers.

What it boils down to, in my humble opinion, is that ultimately, to maintain reader interest, hardware oriented magazines must go micro. To do that either requires technical staff designing micro based projects, with a relatively small reader contribution, a la Circuit Cellar Ink, or to rely heavily on reader input.

Most readers developing with microcontrollers are probably, like myself, doing this on a commercial basis, and can't afford to give their work away, or sell it cheaply enough to be interesting to the magazines. Equally the returns for providing pre-programmed chips are hardly worth the effort.

A simple solution is to work to one or two fixed platform designs, and to perhaps develop these with a more commercial prospective — but then end up with a hardware platform that readers would be free to contribute softyware designs, and perhaps hardware expansions. This need not be too complex, or expensive, as some devices and designs can be in-circuit programmed.

A third option would be for designs past their commercial use-by date to be donated. I probably have a few of these, but my problem is that I am totally disinterested in writing about what I do. I'm happy to talk about it, but hate writing.

Thanks for your comments also, Mr Cook. It was interesting getting more of a 'feel' for the viewpoint of someone who has worked a lot with micros, and I also appreciate your suggestions about taking advantage of chips that can be programmed 'in situ', by downloading from a PC.

I'm not sure about your last suggestion, though. If designs have reached their commercial use-by date, that suggests that they'd be of limited interest and educational value to readers, don't you think?

Moving on again, our next contributor to the debate is Mr Ian Mitchell of Sandy Bay in Tasmania, who can comment from first hand experience as we published his micro-based Chess Computer project in the June 1995 issue. Here's what Mr Mitchell left for us on the BBS:

I've just read January's Forum about the problems associated with projects using programmable devices. I agree that it would be most useful to have the source code available for those people who are interested, but that it's not possible to publish the listings if they are too long.

My chess computer project was published in the June 95 edition, but I did not make available the source code, just the programmer file. I admit that I was trying to make a little money by selling the source code, to those who were interested. Well, I am now happy to make the source code freely available via the EA BBS if you would accept it!

Since I didn't sell any listings (although there was some interest in the listing), I don't think that making it freely available now would cause anyone to be upset (I hope).

I have placed it on my FTP server for anonymous access. The host name is: ftp.research.utas.edu.au and the files are in the /ea directory. Also in the directory is Motorola's freeware 6805 assembler. The files are SC3.ASM, SC3.LST and as5_new.exe.

In the future I would be happy to provide the source code free with any project published in EA.

Thanks for your comments, Mr Mitchell, and you've been very generous about making your own firmware code available. We'll download copies of the files concerned, and place them on the BBS as soon as we can. I'm sure many readers will find them of interest and value.

Another contributor

Moving on yet again, our next comments come from Mr Peter Stuart of Carlingford in NSW, who has also contributed projects to us before. If my memory serves me right, we published some of his designs for radio control circuits late in 1994. Anyway, here's what Mr Stuart has to say:

I read (and reread) with great interest your Forum column of January, regarding microcontroller projects. I am currently working on two microcontroller projects which I hoped you would accept for publication in EA during this year. It came as quite a shock to learn that you might not accept them.

After reading your column, I can understand your dilemma. However, I note that you do not indicate how well these types of projects have been received in the past: that is, how many of a particular design were built. Perhaps a call to several of your contributors of these projects would provide much needed data.

Wanting to get into this area of electronics myself, and liking what I read in your review, I purchased a 68HC705 development kit from Oztronics (Rob Priestly). Perhaps Rob could tell you how many development kits he sold, to give some idea of the demand for source code from those who own a programmer, as opposed to those who would need to purchase preprogrammed chips for a project.

Another point which seems to have been overlooked is that this situation is not new. It has existed ever since microprocessors came on the market during the 1970s. EA did not seem to have a problem with software for the EPROMs used in its projects then. Why are things different now?

A case in point was the EA Car Computer published during 1982. As I recall, preprogrammed EPROMs were available as part of the kit. Suppliers were willing then; why not now? Is the perceived popularity of a project the reason for stockists putting together a kit? If this is the case then we desperately need more USEFUL microcontroller projects to be published.

What IS different now is that microcontroller chips do not seem to be stocked by common parts suppliers. I have had to search around trade suppliers to obtain them, and some suppliers have minimum charges like $100! Again, publishing useful and popular projects will soon get the chips on stockists' shelves.

For the moment, I believe you should make it clear to contributors that you will only accept their submission for publication if they are prepared to offer preprogrammed chips for, say three years after date of publication — or if they are willing to make their source code available to readers, or to EA, for a small fee. Contributors are already paid a publication fee, and they automatically forfeit rights to a circuit design when it is published. The same rules should apply to software design. If a contributor particularly wants to keep the software rights to him or her self, then he or she must be prepared to supply preprogrammed chips and/or attempt to sell the source code under normal commercial conditions.

So my thoughts are that you should publish more microcontroller projects (say three or four a year) under the guidelines mentioned above.

As for the assertion that microcontroller projects are boring, I remember how popular digital clock projects were during the 1980s. These usually contained one large LSI chip and one or two other chips, at most. Very uninteresting to look at, but very popular to build. Perhaps that was because when it was built, it performed a useful function...

Thanks for those comments too, Mr Stuart. I'm sure you're right that it's important for micro-based projects to be really 'useful', and partly this *is* because (a) many people won't build a project nowadays unless there's a kit available; and (b) kit suppliers generally won't 'kit up' for a project unless they believe it's likely to be fairly popular.

You can't blame the kit suppliers for wanting to make sure that a project is likely to be popular, of course. There's quite a lot of work involved in getting a batch of kits together, and once assembled they can represent a significant investment. So if a project involves a custom-programmed micro or EPROM, there's even more reason than usual to make reasonably sure it's going to be popular.

I guess I'm in general agreement with your suggestions regarding the number of micro-based projects we should try to publish each year, and also with the kind of conditions we should try to impose with designers offering such projects. Your suggestion that we talk to people who are already selling micro-based kits and programmers, etc is also a very contructive one, and I'll try to do this shortly as well.

Well folks, that's about all we have space for this month. I still have some more responses on this topic, but they'll have to wait until next time. I hope you'll join us then. ❖

EA's READER SERVICE BBS

As part of its service to readers, *Electronics Australia* operates a Reader Information Service Bulletin Board System (BBS), which makes available a wide range of useful information for convenient access and rapid downloading.

The BBS is ANSI compatible and is currently operational for virtually 24 hours a day, seven days a week, on (02) 353 0627. Use any speed to 28.8kb/s.

THE SERVICEMAN

The time you can waste, chasing faults that don't exist!

My first story this month concerns a frustrating experience I had trying to fix a supposed fault in a fancy stereo tape recorder — only to find out, eventually, that it wasn't faulty at all. There's also some nostalgic tales from a reader who used to look after AM radio transmitters near the end of the valve era, and finally a couple of small items which should leave you with a smile...

Don't you wish your customers would give you an accurate description of the symptoms they are complaining about?

Time without number I've gone off chasing a fault that didn't exist, only because the client could not express himself clearly or accurately. The most recent case had me snuffling around inside an old Sony stereo tape deck, looking for a problem that existed only in the owner's head!

First, a bit of background. The owner is a skilled musician who, over the years, has played in a number of orchestras. And ever since tape recorders became generally available, he has amassed a vast collection of tapes of all sizes and formats. They are a mixture of mono and stereo, recorded at any of the three common tape speeds, so he needs a fairly sophisticated machine to play them.

Some of these tapes feature music in which he was performing and others are of performances that he particularly admires. As a result, he values these tapes highly and has always invested in the best machines he could afford, on which to play them.

Unfortunately, in recent years the only new open-reel machines available have been professional models, at professional prices which have been out of his reach. So when he needed to replace his recorder a few months ago, he chose an 'as new' Sony TC-560. It was quite a few years old, but had been little used and well looked after so my client was well pleased with his purchase.

He set up the machine using the same connections as had been used for the previous one and for several months he played his tapes with much satisfaction. Then one day, he noticed that when playing a mono tape, the sound was coming from one speaker only.

He was well aware of the difference between stereo and mono and was quite certain that, in the past, switching to a mono track caused the music to issue from both speakers. He acknowledged that it wasn't stereo sound, but it had come from both speakers. Yet now it didn't, so there must be a fault in the system and he called me in to find out why.

My first task was to ensure that all the connections were properly made (there was quite a maze of wiring behind his main amplifier) and that all the leads were undamaged. With no fault to be found outside the recorder, it was time to cart the whole assembly off to the workshop for an internal examination.

The first thing I attacked was the Stereo/Mono changeover switch. This turned out to be a simple two pole, three position slider switch which appeared to be faultless — and indeed was so simple that it's hard to imagine how it could fail.

As with much Sony gear, this recorder was grossly over engineered and finding my way around the various boards and sub-assemblies was nearly impossible. What I needed was a copy of the circuit diagram as a minimum, and preferably the whole service manual.

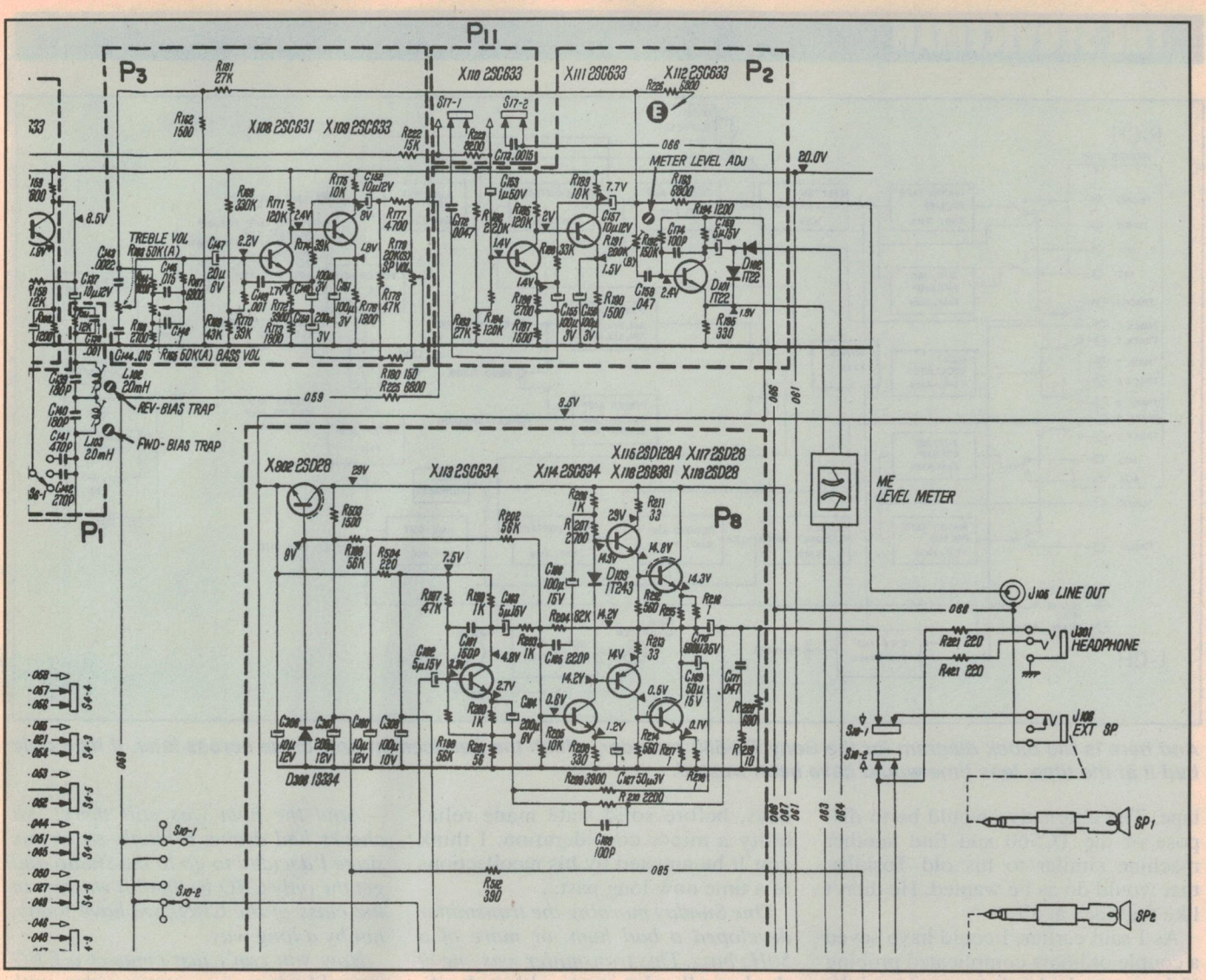
A circuit, anyone?

It was easier to state my requirements than it was to satisfy them. I had quite a hunt among friends and acquaintances, before I found someone who "...thought he had a circuit tucked away somewhere."

It was several days before he called me to come and get it, and 'it' turned out to be the biggest circuit diagram I have ever seen. Printed on A2 paper, it was 840mm long by 594mm wide. That is, equal to eight sheets of A4! The circuitry turned out to be every bit as complicated as a colour TV, and it needed all of that vast sheet of paper to display it.

My first job was to find the stereo/mono switch, and it eventually showed up in the middle of the only (more or less) unpopulated area in the whole circuit diagram. After that, it was easy enough to trace the signal path backwards to the tone control board and forwards to the power amplifier board.

Using a small test amplifier, I was



Part of the schematic for a Sony TC-560 open reel tape recorder, which our Serviceman found himself checking out in search of an elusive problem when playing mono tapes. The schematic certainly helped track down the area of the circuit where the fault might have been ...

able to trace the signal right through the preamp and power amp, proving in the process that the stereo/mono switch was doing exactly what it was supposed to do. That is, it was supposed to switch off the right channel when the source programme was in the left channel — and vice versa. Yet how could the owner be so convinced that a mono signal had come through both speakers?

Then I looked more closely at the configuration of the line output section, and realised that the line output amplifier branched off the signal path ahead of the tone control boards, which confirmed to me that the owner must have been mistaken in believing that business about both speakers being active in the mono mode. So I went back to have it out with him.

After long and slightly heated argument, it turned out that his previous machine had been a Toshiba recorder and he was adamant that it played both speakers when in mono mode. The new Sony was connected in exactly the same manner and as far as he was concerned, it had played in exactly the same manner — or at least he was fairly sure it played in the same manner.

Once I had got the admission that he was 'fairly sure', I pressed the point and asked how many mono tapes he had played since installing the new machine. Now he wasn't at all sure that he had played any mono tapes on the new machine, and I had him!

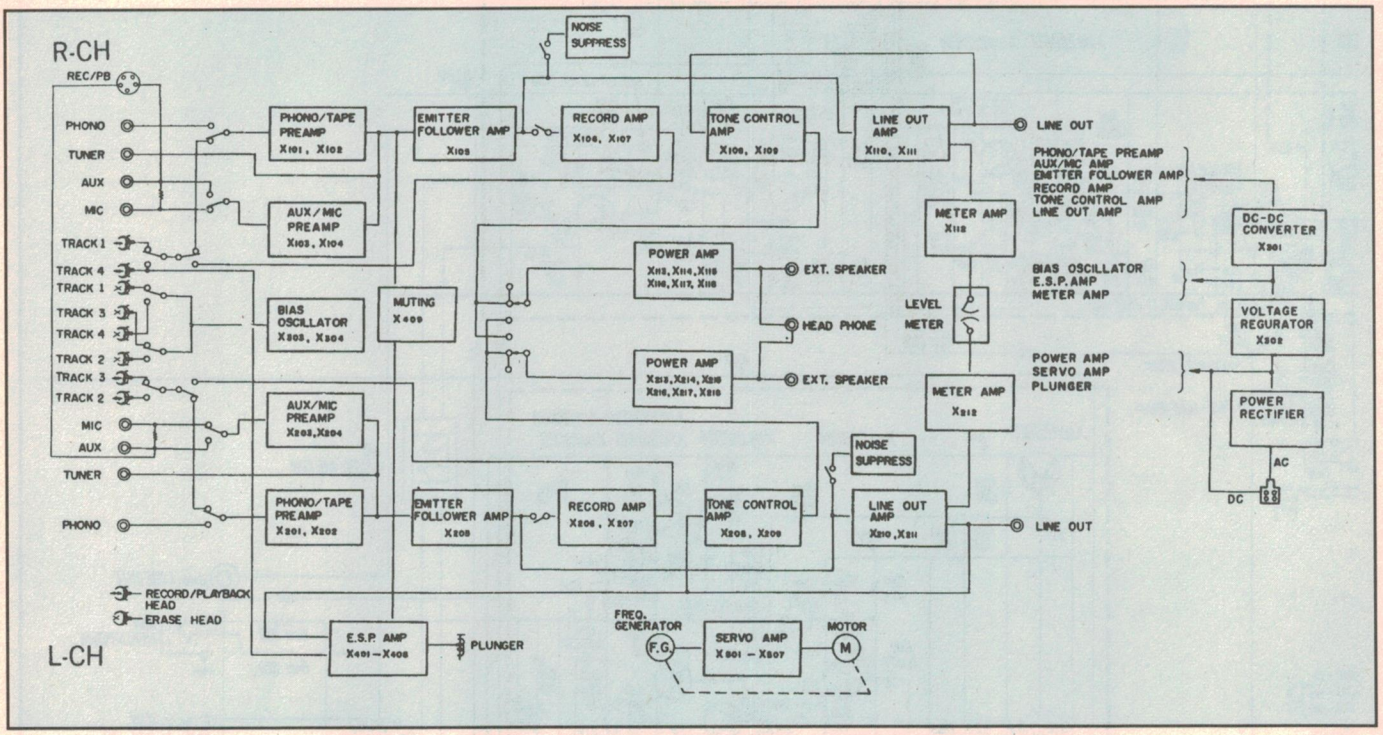
He then admitted that probably there wasn't any fault with the machine, and asked if there was anything we could do to recover the performance he had been expecting.

I explained that without completely redesigning the amplifiers, he couldn't use the line output sockets to drive his main amp in the dual modes as he wanted.

However, I offered an alternative that would give him full control over the stereo/mono modes, at the expense of having to use the recorder volume control rather than the control on his hi-fi amp as the master volume control.

This involved remaking his 'RCA-RCA' line output leads into '3.5mm phono-RCA' leads. When these were plugged into the headphone output sockets, it gave him an output that followed the stereo/mono switch settings, the recorder tone control settings and the recorder volume control.

This meant he had to set the main amp controls to flat before playing a



And here is the block diagram for the Sony TC-560 recorder, which the Serviceman only came across later. If he'd only had it at the time, less time would have been wasted.

tape. The alternative would be to dispose of the TC560 and find another machine similar to his old Toshiba, that would do as he wanted. He didn't like that idea at all.

As I said earlier, I could have saved a couple of hours complicated probing if the owner had only remembered the details of his problem and then given me a more accurate description of what he wanted.

When I took the circuit diagram back to the colleague who had loaned it to me, I was informed that he had found the full manual — and did I wish to borrow it? A quick glance of the block diagram on page three showed all I had needed to know and if I'd had that in the beginning, I would have saved two hours of complicated probing. With friends like that, who needs enemies?

Four in one

Our next item this month is actually four stories, from a single contributor. It's from Gordon Nielsen, of Maryborough in Queensland.

Gordon has been involved with maintenance of country radio stations for longer than he cares to remember, and the yarns he has offered us here date back to earlier days, before solid state made reliability a minor consideration. I think you'll be amused by his recollections of a time now long past...

One Sunday morning the transmitter developed a bad hum, or more of a 50Hz buzz. This transmitter was one of the last all-valve types, although silicon featured all through the power supplies. It was a very good and reliable transmitter.

So after I fired up the old standby unit, I started to examine likely causes until all the logical things had been eliminated. Then I spent a lot of time on the audio side of the transmitter, which was the old Heising/high level modulation type. This uses a number of stages of amplification up to a pair of big pushpull valves, delivering over one kilowatt of audio into a big modulation transformer, the secondary of which is connected across a big iron cored choke — through which the current supplying the final RF valve flows. (In this case approximately 600mA from a 5kV power supply. This represents about 3kW of power, and at 66% efficiency, equals 2kW of carrier power modulated by the 1kW of audio mentioned above.)

Finally and in desperation, I disconnected the audio side from the RF side — and the hum was still there! All checks had drawn a blank, so at this stage I decided to go to the studio and get the only CRO we had. It was not in the class of the CROs we have today, not by a long way.

Now you can't just connect a CRO any-old-where in a transmitter with 5kV all over it and in this case, the hum seemed to be everywhere throughout the RF side. It was not at all easy to see on this old instrument, becausé it was actually just a near-invisible spike.

In desperation I changed the crystal — and the hum went away! So the fault was fixed. I was content to put it aside until another day. After all, it was a Sunday.

So how can a crystal cause hum or buzz? Well, this transmitter was designed to have a crystal plugged into the usual seven pin socket, and the valve oscillator generated the carrier frequency directly.

However, there had been a slight frequency change and the new crystal was still in a seven pin plug-in box. But this one oscillated at four times the required frequency, with its own solid state oscillator circuit and an IC divide-by-4 to supply the correct carrier frequen-

cy into the existing oscillator valve in the transmitter.

Now, on the seven pin socket, two pins have 10V AC which was originally provided to heat a thermostatically controlled 'hot crystal'. The modern crystal unit uses this 10V AC to provide a rectified DC voltage for the new crystal unit, by way of a 7812 regulator.

Well, the small electro filter capacitor had gone open circuit, and the result was a spike on the output of this unit every so many RF cycles. It was almost impossible to see on the old CRO. This was many years ago and I would have found it interesting to study the problem on the CRO I have today...

Years ago things were quite different to what they are now. Then, transmitters were usually far out in the bush; power was necessary but wasn't as reliable as it is today. Telephone lines were usually old copper wire pairs on wooden poles by the side of the road. Indeed some of these were owned by the radio station themselves, so they could get their programme from the studio to the transmitter. Many things were primitive by today's standards, and the technicians had many and varied duties.

The old open-wire landlines were a constant source of trouble, with tree limbs falling on them, birds flying into them and fishing lines wrapped around them — particularly near the creek. There were also lightning problems (usually on the last pole), and so on.

Landline problems

We had three pairs on these poles, and one callout was a bit of a grin.

As I drove to the transmitter, I would keep an eye out for problems on the overhead wires. On this occasion I suspected that one leg of the control line was shorted to one leg of the program line. Suddenly, there it was...

Near a dam, a duck had flown into the lines midway between poles. Its neck was caught between two wires and it had flipped over, twisting the wires together on either side. It was still there, hanging suspended by its neck!

I searched along the road for a stick and the best I could find was just too short. Then in the boot of the car I found a bag of chook food. I put that on the ground under the bird, but could still barely reach the wires. I wanted to get the stick between the wires so I could untwist them and so release the unfortunate creature.

However, I found the fowl was still alive and every time the stick got near it, it reached out a foot to try to grab the stick and only succeeded in pushing it away. But I persevered and eventually managed to free the bird — which thudded to the ground, apparently senseless. The wires sprang apart and the fault was fixed, without going anywhere near the transmitter or calling out the linesman.

The bird lay on the ground, not looking very healthy at all. In those days we used to send 48V pulses through the control lines, and the bird had been copping these in the neck for goodness knows how long. I did continue to the transmitter, just to check it out, but on my way back saw that the bird had recovered and flown off.

Then on another morning a transmitter fault cause me to turn on the old standby transmitter. But there was a loud singing arc from an inaccessible part of its interior, and it also went dead. I now had two dead transmitters, at prime time, and for a while went from one to the other trying to work out which would be the quickest to fix.

After some time, I got one back on the air again and stood looking at the more difficult fault. Then the power failed and we were off the air, again!

Now in those day, we did have an old diesel alternator set that could be started manually. But it was hard wired to only one of the transmitters, and you've guessed it already — I had fixed the wrong one...

Finally, there was the night I went to the transmitter to do some late night maintenance. For a lark, I phoned the night announcer and, pretending to be a drunk, gave him a stir.

It didn't occur to me that the police would be called and after checking out the studio end, they came up to the transmitter. I had to explain who I was and what I was doing there, and next day the boss had to square off the local police sergeant...

Life was never dull.

Thanks, Gordon. Those stories served to remind me of a period in my youth when I had some friends involved with country radio stations. One chap was both technician and announcer and one morning, a failure of some kind called him away from the studio.

I was left in charge, to explain to listeners where their usual announcer had gone and what the next record would be — if I could find it, etc. It cost my so-called friend a lunch and more than a few beers before I was able to accept his apologies.

Again, thanks Gordon. Your stories remind us that electronic servicing is not all TVs and videos.

Smile material

Now, before I close this month's column, I've got a couple of short 'Funnies' that have been sitting around on my computer for months. One was originally intended for the 'Just for a laugh' segment which we had to kill off some months ago. The other appeared in the New Zealand *ETSA Newsletter*, and is just too good to be left there.

The first comes from Dave Jeanes, of Currumbin Waters in Queensland. He reports...

The customer, who lives on the beachfront, complained of a snowy picture in the late evening. The serviceman advised him that salt was collecting on the antenna, and the dew which formed each evening was causing the salt to form a shorting path across the antenna connections. The solution was to occasionally hose down the antenna.

A neighbour, who witnessed this corrective action, commented one day "By Jove, that's really come on since you started watering it!"

Thanks, Dave. I've watered my own antenna occasionally, but I've never had a neighbour making smart-aleck remarks about the exercise.

And now for the final story. For several years now I have been getting copies of the newsletter published by ETSA (Electronic Technology Services Association), the New Zealand equivalent of Australia's TESA.

Most editions of the newsletter are full of doom and gloom about the draconian restrictions and limitations being imposed on the electronic service industry by the New Zealand government. However, to relieve the almost endless misery, the editor runs an occasional story from the coal face submitted by members of the association.

Some of the contributors have the weirdest sense of humour, as the following anecdote suggests. I hope you enjoy it as much as I did.

It comes from one who signs himself 'Arnold'. I haven't got his full

Continued on page 64

AUTOMOTIVE ELECTRONICS

with NICK de VRIES MIAME, AMSAE, FI Diag.E..

The VK EFI Commodore's LE-Jetronic system

This month we're looking at the Bosch LE-Jetronic fuel injection system used in the 'EFI' version of the VK Commodore. While simpler than many of the later systems, and using an analog electronic control module rather than one based on a microprocessor, the LE-Jetronic system used in the EFI version can still give even experienced technicians a few headaches...

GMH released two quite different electronic control systems for the VK, both on a similar in-line 3.3 litre six cylinder (leaded fuel) engine: the EFI version covered here, and the Electronic Spark Timing (EST) version which may be covered at a later date.

Briefly, the VK EST Commodore has a Bosch microprocessor controlled system that controls spark timing and dwell depending on relevant RPM and engine conditions. It is also quite easy to identify, because fuel delivery is accomplished via an age-old method: carburation.

However the EFI system is quite different. It has the associated EFI hardware — an electronic control module (ECM), injectors, an air flow meter (AFM), a coolant temperature sensor (CTS), a fuel pump, etc (see Fig.1). But the ignition system is of an electronic high energy type, with mechanical and vacuum advance incorporated with the distributor. The ECM does not control spark timing or idle speed, so it is not classed as an engine management system. Hence the label 'EFI'.

The ECM does not contain a microprocessor, RAM or ROM. It is an analog control unit, consisting of many resistors, capacitors, transistors, comparators, op-amps and hybrid circuitry — quite a masterpiece in analog technology, really. You could say that it is a black box (actually silver) that converts input voltages (AFM, CTS etc.) into calibrated-width output pulses (the injection signals).

The frequency of the output pulse, is related to the input trigger, which is derived from the primary ignition system. Being an analog system, it has the disadvantage of not being able to save and report any diagnostic codes.

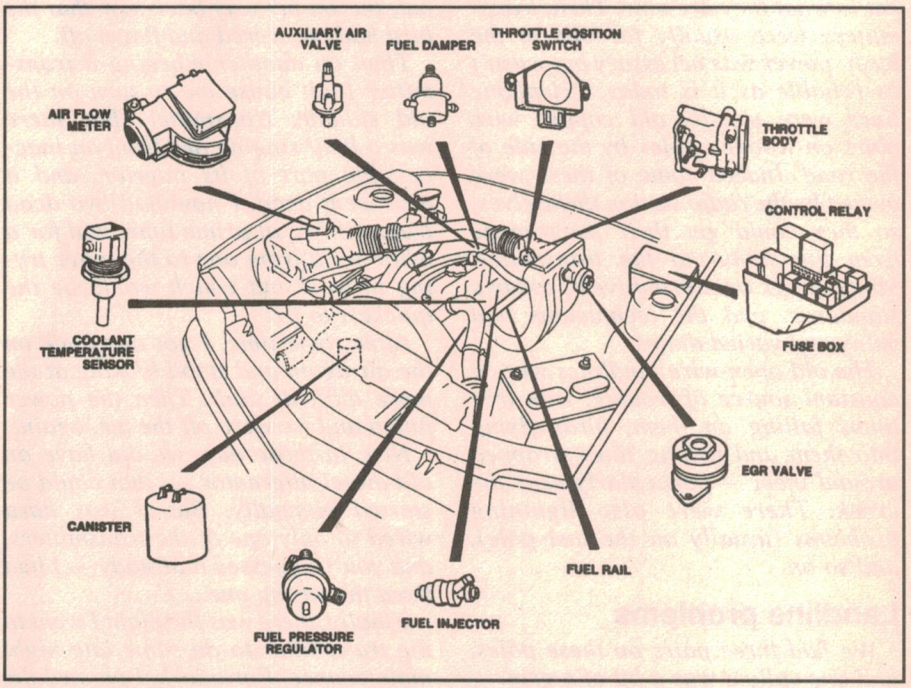


Fig.1: The main components of the VK EF1 Commodore's LE-Jetronic system, and their locations. (Courtesy of the VACC.)

Power supply?

When fault finding on an EFI VK that has no injection, ensure that the power supply is OK and the ignition system is operating correctly. A lot of time and money has been spent, unnecessarily, finding an injection fault on an EFI VK that only had a simple ignition failure!

Also, when checking for ECM supply voltage or fuel pump operation, the engine must be cranking or running. The EFI relay (on this system it is called the tachometric relay, see Figs.2a and 2b) is a safety device that controls power supply to the ECM and fuel pump. It is energised by either the cranking terminal on the ignition switch or, when the engine is running, by the negative side of the ignition coil (primary pattern).

The relay control circuit is a 555 timer, in basically a resettable monostable mode. So if the trigger signal falls below a certain frequency, approximately 200rpm, the relay resets and isolates power to the system. This forms the safety circuit to ensure that if the engine is not running, then the fuel pump is disabled.

It should also be noted that the crank input (pin 50 — see Fig.3) to the relay overrides the timer function. So if the engine is not cranking or running, the ECM and fuel pump are isolated and are not energised — even with the ignition

key in the 'on' position. Therefore when testing for ECM supply integrity or fuel system checks this relay must be bypassed.

To achieve this task remove the fuse panel cover (on the passenger side rear of the engine bay) and then remove the tachometric relay. Then make up a 10A fused lead and connect as shown in Fig.4.

If power is available at pin 30 of the tachometric relay and once the bypass link is installed, the fuel pump operation should be heard. Battery power should also be available at pin 9 of the ECM, pin 9 of the airflow meter, pin 18 (middle pin) of the TPS, the auxillary air valve and the injectors — see Fig.5.

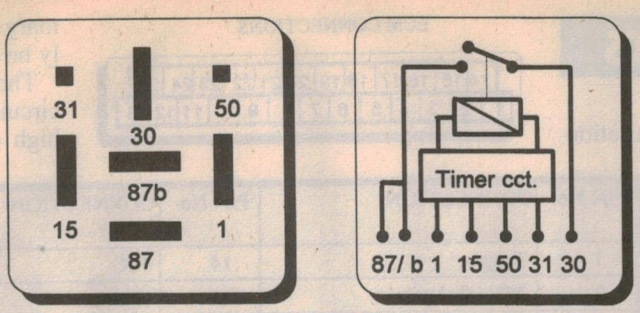


Fig.2: The external connections for the tachometric relay are shown at left (a), while the internal connections are shown at right (b).

Inputs and outputs

The system uses various input signals to determine the output injection pulse width.

The air flow meter provides a calibrated output voltage relative to engine load. Acceleration enrichment is achieved by the TPS (throttle position switch) idle contact opening and also overswing of the AFM flap. This is one reason why the AFM flap spring tension should not be adjusted...

The CTS has a negative temperature coefficient and provides the ECM with engine temperature information. As the engine temperature increases, the resistance of the CTS decreases. The ECM will then adjust the injector on-time accordingly. Fig.6a and the table in Fig.6b illustrate the ECM numbering and a summary of connections.

The fuel system

The fuel pressure is set to 250kpa at idle and 300kpa with the vacuum port to the pressure regulator vented to the atmosphere. Fuel pressure can be checked very easily, by attaching a fuel pressure gauge (approx 0 -10 bar range) to the Schreader valve on the front end of the fuel rail. (Remember when removing the gauge — always replace the cap on the valve!)

I have encountered a VK Commodore (actually several) with very high fuel consumption, hard starting, very rough idle and sometimes 'no go' at all. After installing a fuel pressure gauge the problem became obvious — the system pressure was approximately 6 bar (600kpa).

First thought was that the fuel pressure regulator may have been jammed, so a few gentle taps were administered; but alas no change. The return fuel line from the fuel pressure regulator was then removed and a bypass fuel line attached (the other end inserted into an approved fuel container). Then an attempt was made to start the vehicle again. This time the engine burst into life and the fuel pressure returned to normal.

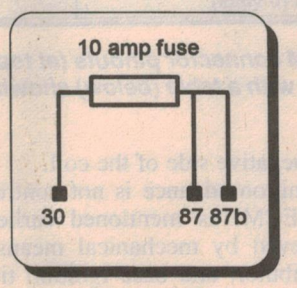


Fig.4: The connections for a cable used to bypass the tachometric relay, for convenient ECM testing.

Further investigation revealed a blockage in the return line to the tank. Once the blockage was cleared, the spark plugs dried and the fuel lines reconnected, the vehicle ran normally.

The reason behind the above discussion is to remind you that an EFI vehicle's fuel and mechanical system must be checked and if neccessary repaired, before any electrical/electronic diagnosis is attempted.

Fuel pump control has already been discussed at length in many places, and when working on EFI systems the normal safety precautions apply:

- Never test an EFI fuel pump on the bench. In situ, EFI fuel pumps are normally immersed or saturated in fuel, so little air is available to cause ignition. However, in free air the air/fuel ratio changes and a fire or explosion may result.
- Always relieve fuel system pressure before disconnecting fuel system components.

Another fuel test that may be performed, to check the health of the fuel pump, is to check fuel delivery. As described before, disconnect the return fuel line, redirect it into an approved calibrated vessel and then operate the pump (by bypassing the tachometric relay). It should deliver approximately 900ml in 30 seconds at 250kpa. If the result is low, it may be wise to check the fuel filter, power supply and wiring before condemning the pump.

The injectors

The injector solenoids have a resistance of 16 ohms, and they are wired in two groups of three. Positive 12V is supplied to one terminal of each injector (via the tachometric relay), while the other terminal is grounded by the ECM (pins 12 and 24).

The ECM has only one injector output transistor, so the injectors are operated simultaneously, once every crankshaft revolution. There is an injection pulse for every three spark pulses.

Injector flow rates and patterns should never be discounted when faultfinding on EFI vehicles, particularly vehicles of this age. One way to check the integrity of the injectors, on the car, is to perform a delta power balance test which is available on most modern tunescopes.

The tunescope accomplishes this test by disabling the spark to each cylinder, in turn, and then measuring the exhaust gas hydrocarbon peaks and decrease in rpm. It can then report not only power balance information, but also the efficiency of each injector. The technician can then compare the hydrocarbon variations and determine any

PIN NO.	FUNCTION
1	Connected to negative side of the ignition coil (System Trigger)
15	+12 volts supply from ignition switch (via 15 amp fuse)
30	+12 volts supply from battery (via fusible link)
31	Earth (0 volts)
50	Crank input (Starter signal)
87	Fuel pump +12 volt supply
87b	ECM,Injectors, Air Flow Meter, TPS and AAV +12volts supply

Fig.3: The tachometric relay connections and their functions.

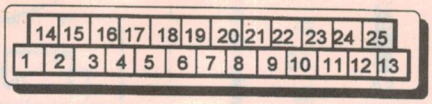
injector-related problems.

If the results show too much variation and provided that the system has no other faults, the injectors may have to be removed and tested on an injector test bench.

On the earlier L-Jetronic Bosch systems, cold start enrichment is accomplished by incorporating a cold start injector and a thermo-time switch. When the engine is cranking, and is cold, the thermo-time switch applies +12V to the cold start injector to assist cold starting. But remember that the cold start injector should only operate in crank mode.

The VK LE-Jetronic system does not use the above hardware. Instead enrichment is provided by the six 16-ohm injectors and the ECM samples the crank signal (pin 4) and the CTS (pin 10), in order to modify the injection base pulse duration.

ECM CONNECTIONS



PIN No.	CONNECTION	PIN No.	CONNECTION
1	Trigger	14	N/C
2	TPS idle contact	15	N/C
3	TPS wide open throttle	16	N/C
4	Crank input (Starter signal)	17	N/C
5	Earth (0 volts)	18	N/C
6	N/C	19	N/C
7	Air Flow Meter (load)	20	N/C
8	Air Flow Meter (reference)	21	N/C
9	+ 12 volts supply	22	N/C
10	Coolant Temperature Sensor	23	N/C
11	N/C	24	Injectors
12	Injectors	25	Earth (0 volts)
13	Earth (0 volts)		

Fig.6: The ECM connector pinouts (at top), looking into the plug, together with a table (below) showing the connection details.

Ignition system

The ignition system comprises a distributor, coil, leads and an ignition module. The distributor contains an inductive pulse generator that triggers the ignition module, which in turn grounds the negative side of the coil.

Ignition advance is not controlled by the ECM, as mentioned earlier. It is achieved by mechanical means in the distributor, and base ignition timing is set to 12° BTDC (before top dead centre).Considering that the primary ignition pattern is the system trigger, it should be obvious that if there is no primary switching then there will definitely be not be any injection.

The switching of the primary ignition circuit is controlled by a four-pin Bosch high energy ignition module, the connections for which are tabled in Fig.7. The module determines the required dwell and, via pin 16, switches the coil to ground. This particular module also incorporates a current control mode, and as a result a very low coil primary resistance can be used.

The resistance of the pulse generator winding inside the distributor is approximately 1000 ohms. This generates an AC voltage that triggers the module.

This AC output can be measured by rotating the distributor and testing between pins 3 and 7 on the module. The waveform generated is not sinusoidal, but the peak and RMS voltages can be measured on most reliable multimeters (an oscilloscope is probably preferable). Pin 15 is +12 volts and the unit grounds through its body and mounting screws. Ensure thermal paste is used whenever installing the module.

Input devices

As engine load and air flow vary, the output voltage from the air flow meter

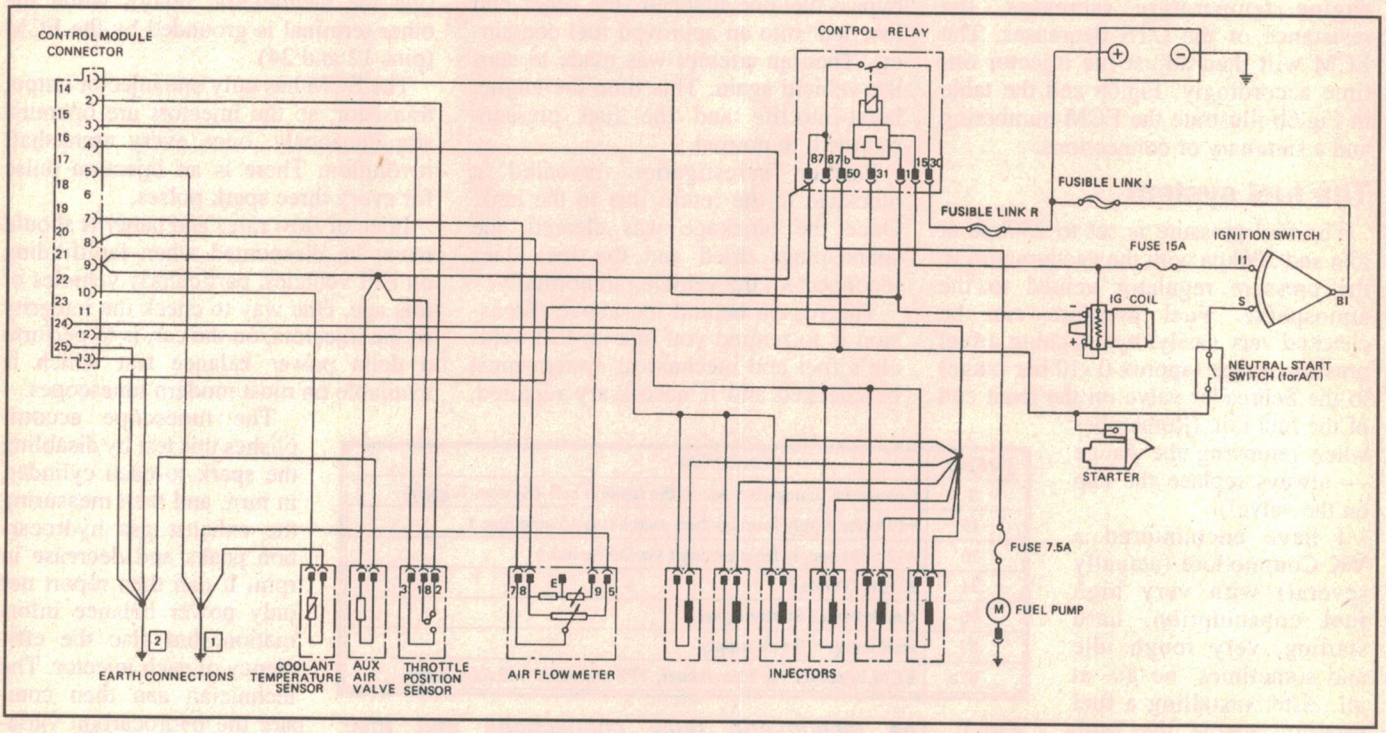


Fig.5: The main electrical schematic for the VK EFI's LE-Jetronic system. (Courtesy of the VACC.)

PIN No.	FUNCTION
Body	Ground (0 volts)
3	AC trigger
7	AC trigger
15	+12 volts
16	-ve side of coil

Fig.7: The connections of the electronic ignition module.

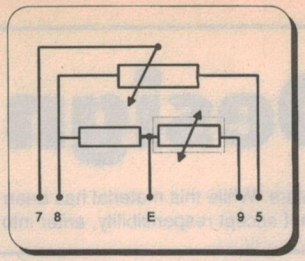


Fig.8: The internal connections for the air flow meter (AFM).

Temperature (Celsius)	Resistance (Ohms)
0	5.4 - 6.3 K
20	2.3 - 2.7 K
80	300 - 350
100	170 - 210

Fig:10: A table showing the expected resistance values for the coolant temperature sensor (CTS) at various temperatures.

also varies. The ECM uses this voltage to determine engine load. On initial acceleration the AFM flap will overswing to provide acceleration enrichment. The overswing, dampening and lean cruise modes were calculated and set by Bosch after many many hours of intensive research, so adjustment is not advisable. The AFM pinouts and voltages can be seen in Figs.8 and 9.

The variable resistor in the dotted lines in Fig.8 is the air temperature sensor. It is physically located inside the AFM and protrudes into the intake air stream.

Because air temperature relates directly to air density, the changing resistance of this device biases the load output voltage produced at pin 7 of the AFM, to compensate for any temperature/density variations.

It must be remembered that any air leaks in the intake system will result in a leaner mixture. An air leak after the AFM does not deflect the AFM flap, so extra fuel is not provided for the extra air induced and therefore a lean mixture results. Always check the inlet manifold gaskets, throttle body, ducting, clamps and EGR valve for air leaks, and repair if any exist.

If the intake system is sealed, then the idle CO% adjustment can be done.

CO% adjustment is achieved by turning the screw under the small round cap on the AFM. The screw opens and closes a bypass channel, inside the AFM, so that air can be bypassed around the flap and therefore a richer or leaner idle mixture can be attained. Idle CO% should be adjusted with the engine at operating temperature to approximately 0.5 - 1.5% CO, at (850 +/-50)rpm.

The CO% must be set at idle, because if the engine rpm is too high, the AFM flap will be open. This offers the incoming air a path of least resistance, so the air will not travel through the bypass port and therefore above idle rpm the adjustment has little or no affect.

The coolant temperature sensor is an NTC (negative temperature coefficient) device, as discussed before, so it is obvious that as the engine temperature increases the resistance of the CTS will decrease. The unit is easy to test and if faulty will affect mixture, and therefore emissions, quite noticeably. The resistance/temperature characteristic is tabled in Fig.10 and if the voltage at pin 10 of the ECM does not change as the engine warms up, check the sensor and the wiring to it.

Another device that modifies the injection base pulse width is the TPS, which provides information to the ECM regarding the mode of operation of the engine. These modes include acceleration, cruise, heavy acceleration and deceleration. The TPS is a three-pin device that has an idle contact, wide open throttle contact and +12 volts — see Fig.11.

Testing the TPS is a relatively simple task. The middle pin, connecting to +12V, is switched to either of the other two pins depending upon throttle depression. It is very important to ensure that the adjustment of the idle contact is correct and it should operate (open) just as the throttle is depressed.

The correct method for adjustment of the TPS is to loosen the screws that hold it to the throttle body, set the switch and retighten the screws. The wide open throttle (WOT) contacts are not adjustable and they close at approximately 75% of throttle travel.

Idle speed should always be adjusted via the idle speed screw on the top of the throttle body, so never adjust the TPS or idle speed by adjusting the throttle plate stop. Idle speed should be set to (850 +/-50)rpm with the engine at operating temperature.

The three input devices outlined above are constantly monitored by the ECM. The ECM modifies the injection base pulse width according to the voltages they present. If the vehicle has mixture related problems and the fuel and mechanical systems are within specification, a good place to start investigation would be to check the integrity of the power supplies. Then check these sensors, because if faulty, any one of these sensors can cause minor or major mixture problems.

The ECM does not have diagnostic code capabilities, so the good old fashioned 'seek and destroy' method of faultfinding with a multimeter or scope must be used.

The VK EFI system is a fairly simple system, compared to the later model vehicles. But this does not mean that it is always easy to repair, and there are some problems that can cause headaches for even the experienced technician. So good luck with your diagnosis and repairs.

Until next time, 'bye. ❖

PIN No.	FUNCTION	VOLTAGE
5	Earth	0 volts
7	Load Signal	approx 1.5 - 7.9 volts
8	Reference voltage	4 volts below supply (pin 9)
9	Supply	+ 12 volts*
E	Calibration	N/C

Fig.9: The AFM connections and expected test voltages, when +12V is connected to pin 9.

PIN No.	DESCRIPTION
2	Idle contact
18	+12 volts
3	WOT contact

Fig.11: The connections for the throttle position sensor (TPS).

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Sound triggered alarm

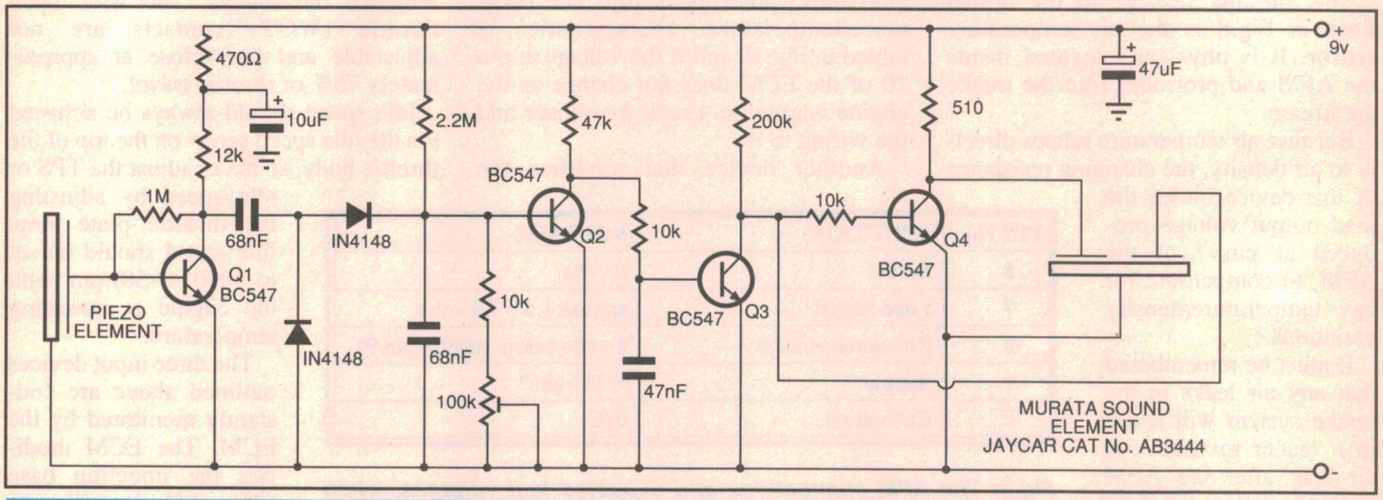
This simple alarm will sound when triggered by a low level audio signal, such as that from a mobile phone or small travel alarm clock.

The microphone is a piezo element from a musical greeting card which produces a 20 - 90mV signal, and it is connected to Q1 wired in a self biasing configuration. The signal from the microphone is rectified and passes to Q2 which, with the 100k trim pot acting as a trigger level control, switches Q3 off. this allows the oscillator based around Q4 and the second piezo element to start producing a loud beeping tone in time with the triggering signal.

The oscillator in this circuit is quite interesting in that these three-lead piezo transducers have a section of the active surface insulated from the rest of the driven electrode, and the small voltage developed between this section and ground is used as feedback to the transistor, locking the oscillator into a frequency determined by the resonant frequency of the piezo transducer.

Powered by a 9V battery, the circuit draws 600uA standby current and 13mA when activated, giving an approximate three-month battery life when used with a mobile phone in normal business use.

D.J. Burggraaf,
Thomastown, Vic. **$20**



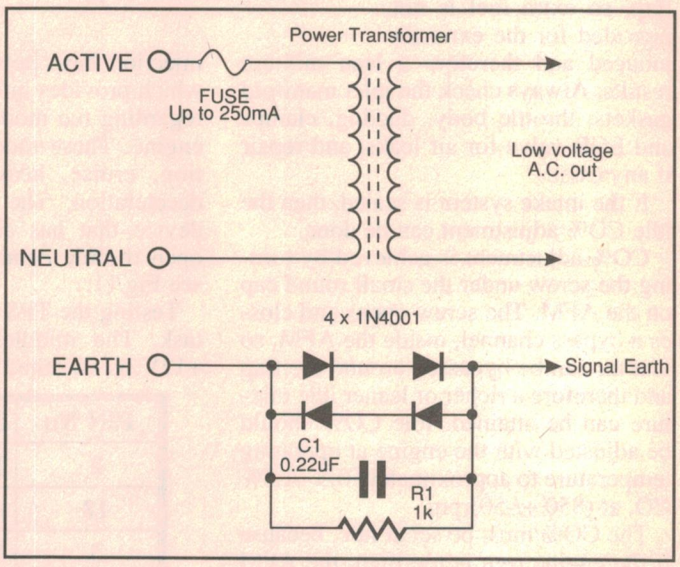
Earth loop eliminator

A tricky design problem arises when mains powered audio equipment needs to be connected to other mains powered equipment. For safety, all external metalwork should be earthed, but quite often this needs to be connected also to the 'signal' earth return. This can cause mains hum, from currents circulating in the wiring shields via the mains earth wires. These currents are added to the desired signal.

This circuit allows hum free operation, but will not allow a voltage greater than 1V RMS to develop between the mains earth and signal earth. Thus, in the event of a transformer primary winding short, the fuse will blow even if the short is to the secondary winding, rather than the transformer core or metalwork.

The two pairs of back-to-back 1A diodes, D1-D4, allow the signal earth to swing within their 2.8V p-p range when so driven by an external signal earth, and R1 will float it to 0V when the equipment is operated stand-alone. While C1 maintains RF shielding, a smaller capacitor, say 1nF, may be added in VHF applications.

The resistor value should not be reduced, nor the capacitor value increased, as either change can allow the earth loop current to rise to produce a noticeable hum level. If the fuse needs to be heavier than about 250mA, say for a high power amplifier, then this circuit should NOT be used. Use it for the lowest power equipment in a connected group, but retain the proper, solid ground for anything that has a heatsink or fan.



Jim Sosnin,
Montmorency, Vic. **$30**

Sound intensity meter

Sound levels of up to 115dB can be measured with this meter, which includes a direct meter readout and a battery check function. The microphone is a normal two-lead FET or electret type, and its output signal is developed across the 15k load resistor R1. This signal is amplified by IC1a which has a gain of either 2.8, 15.8, 89.4 or 504.9 (15dB steps), set by the range switch SW1.

IC1b buffers the AC signal, which is rectified by D1 and filtered by R5 and C9. Then it is again buffered by IC1c and the output fed into a 250uA FSD panel meter (with a scale reading from 1 to 10) via R7, R8 and RV6. D2 and D3 protect the meter from overload.

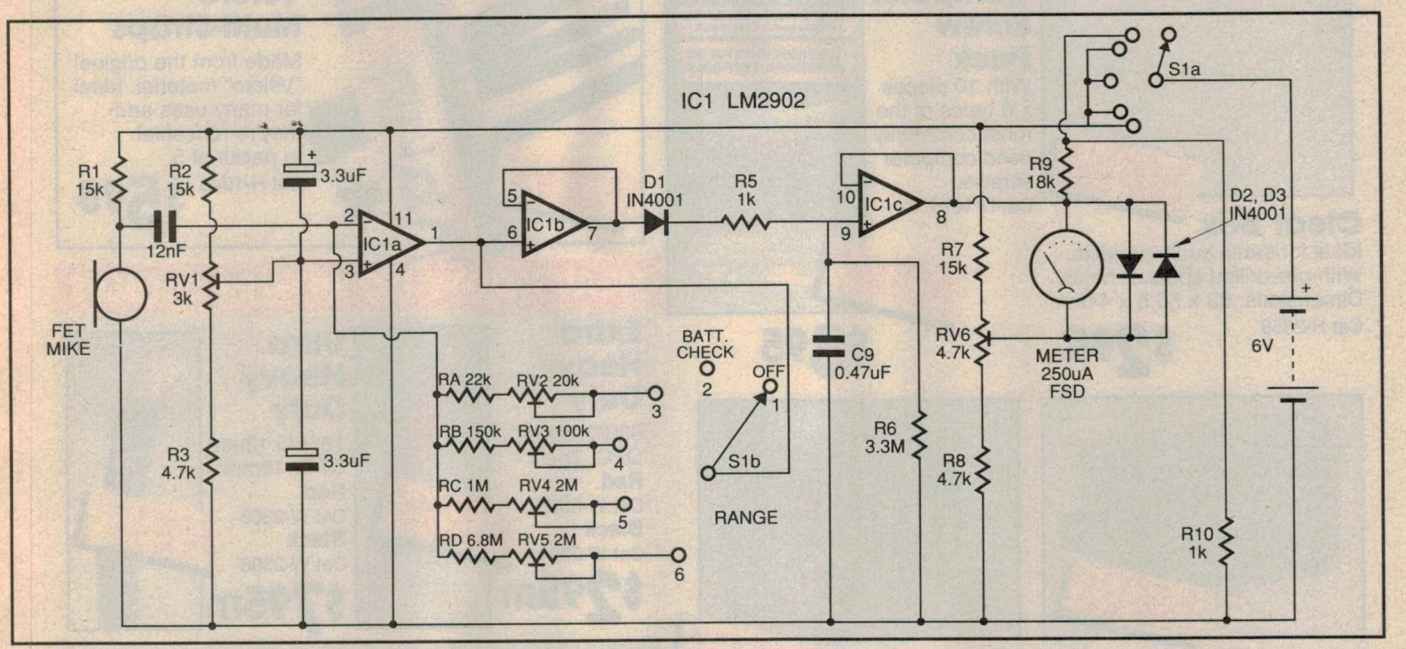
The second position of the rotary switch is a battery check, which places R10 across the battery as a load, and R9 is a scaling resistor in series with the meter — which, when RV1 and RV6 are set correctly, should read 10 with a healthy 6V supply.

To set up the meter, select the highest range with the rotary switch S1 (position 4), and adjust RV1 to read *below* 0 on the meter, and then set RV6 so that the meter reads 10 on battery check. Keep repeating this process until these readings are achieved. This procedure must be performed in a quiet room so that noise doesn't upset the readings, and the meter needle must reverse and rest against the end stop.

The only real way to calibrate the meter is to compare it with a calibrated sound level meter, but if you only want to do a few comparative measurements, then a simple way is to use an audio signal generator with an adjustable output volume.

Switch SW1 to the highest range and adjust the volume of the generator until the meter just reads 0. Move the switch down a notch (position 4) and adjust RV3 to give a meter reading of 10. repeat this procedure for the other two ranges to give a minimum sensitivity of about 55dB.

D. Francis,
Cannonvale, Qld. **$30**



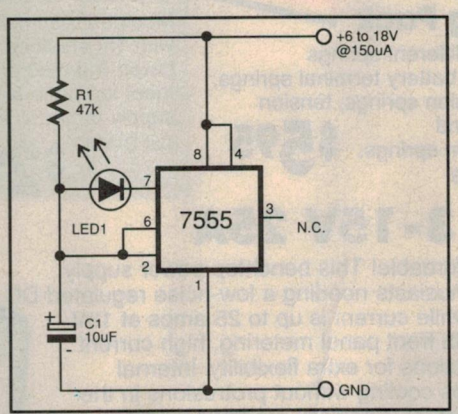
Low current LED flasher

This simple LED flasher uses only three components to brightly flash a LED with very low power consumption. Instead of the usual LM3909, this circuit uses the cheaper CMOS version of the 555, the 7555.

The circuit operates as a normal astable multivibrator, but instead of driving the LED from pin 3 as usual, the circuit makes use of the capacitor discharge current flowing through pin 7. When power is applied to the circuit, C1 charges through R1 until the voltage on pin 6 rises above 2/3 Vcc.

At this point the 7555 discharges the capacitor through pin 7 to ground, via LED1. As the capacitor voltage falls to 1/3 Vcc, the pin 7 is disconnected, allowing the capacitor to charge up again.

These short, high current pulses as C1 discharges cause LED1 to flash, giving a bright, eye catching display whilst consuming only 150uA from the supply. The circuit can be powered from 6 to 18 volts, and while pin 3 is not used here, there is no reason why its output could not be used for other purposes.



Graham Cattley,
EA project designer.

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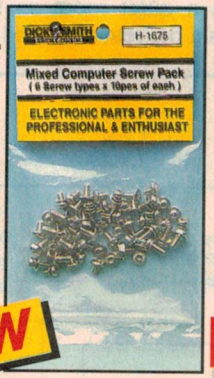

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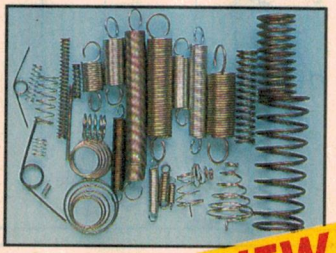

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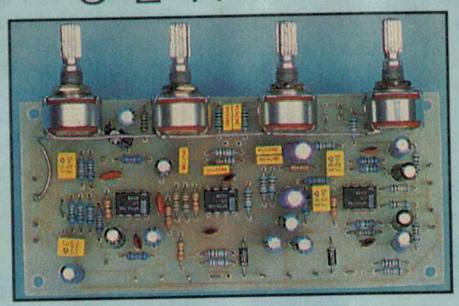

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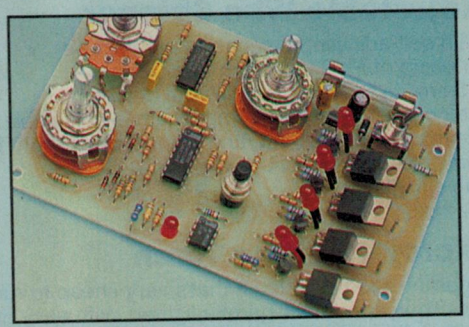

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A safe, simple light sequencer or light chaser for decorations, party lights or advertising signs. Four lamp outputs are provided each of which drives filament lamps or LEDs up to 2 amps. Ten connected in parallel, or series combination for total channel output of 24 watts. Uses any battery or DC supply between 8V and 18V with a power rating at least equal to the total lamp load to be used. Kit comes with silk-screened, solder-masked PCB, components and hardware items. (Plugpack or battery not included.)

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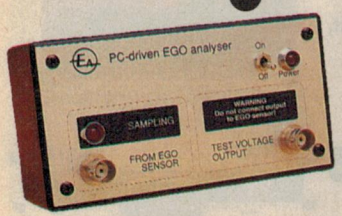

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Construction Project:

PC-DRIVEN AUDIO SWEEP ANALYSER - 2

Here is the second of two articles describing our new PC-controlled audio signal and sweep analyser, based on the low cost DDS frequency synthesiser and ADC modules described in the September issue, and the dual power supply module described in the December issue. This month we look at the construction and setting-up of the analyser, which is capable of making measurements which compare very well with professional systems costing many times its modest outlay.

by TIBOR BECE and JIM ROWE

As you can see from the photos, the audio sweeper is housed in a plastic instrument case, of the same size as that used for the RF sweeper. And the construction is very similar, with the YADDS-1 and ADC modules mounted on a horizontal shield plate along with the power supply module (which is in this case the new dual supply module). This shield plate mounts in the bottom half of the case.

The additional generator 'output circuitry' and analyser 'front end' circuitry given in Figs.1 and 2 last month is all on a new PCB which mounts vertically in the front of the case, supported by the front panel switches. This makes the complete instrument quite easy to assemble and adjust. The IEC mains input connector is again mounted on the rear panel, along with the DB-25 plug used to connect the sweeper to the PC's printer port.

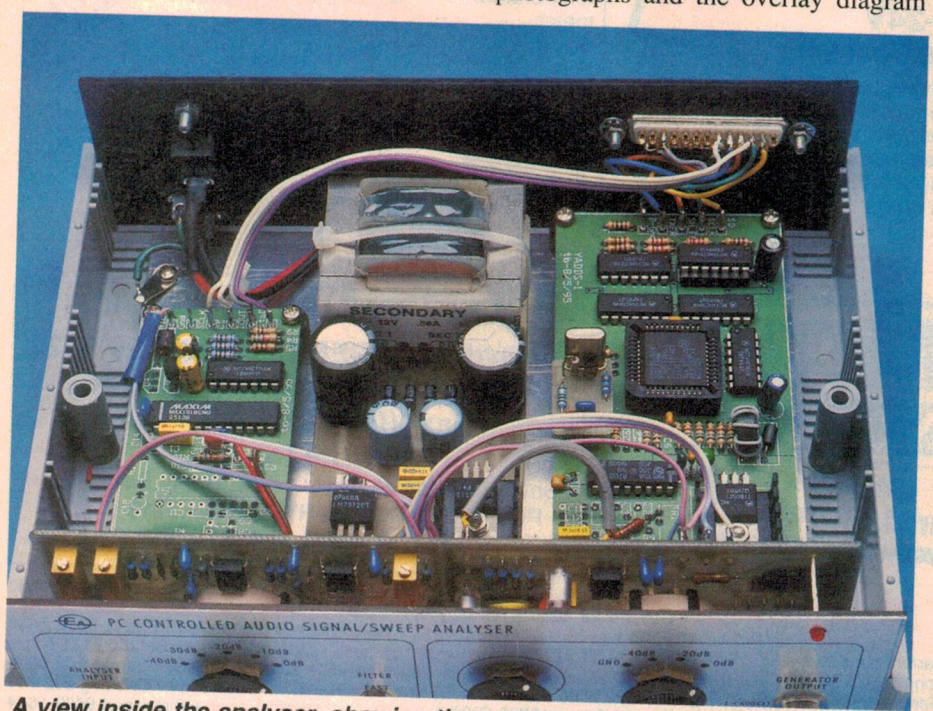
Assembly of the vertical PCB should be fairly straightforward, if you use the photographs and the overlay diagram of Fig.6 as a guide. The main things to watch are the orientation of the two rotary switches SW1 and SW3, op-amps U1-3, diodes D1-4 and solid tantalum capacitor C4. There are only two small wire links on the board — a short straight one between R22 and R27, and a bent one just below R27.

By the way, to facilitate making the various connections between this PCB and the YADDS-1, ADC and power supply boards more easily later on, it's a good idea to fit PCB terminal pins to the board.

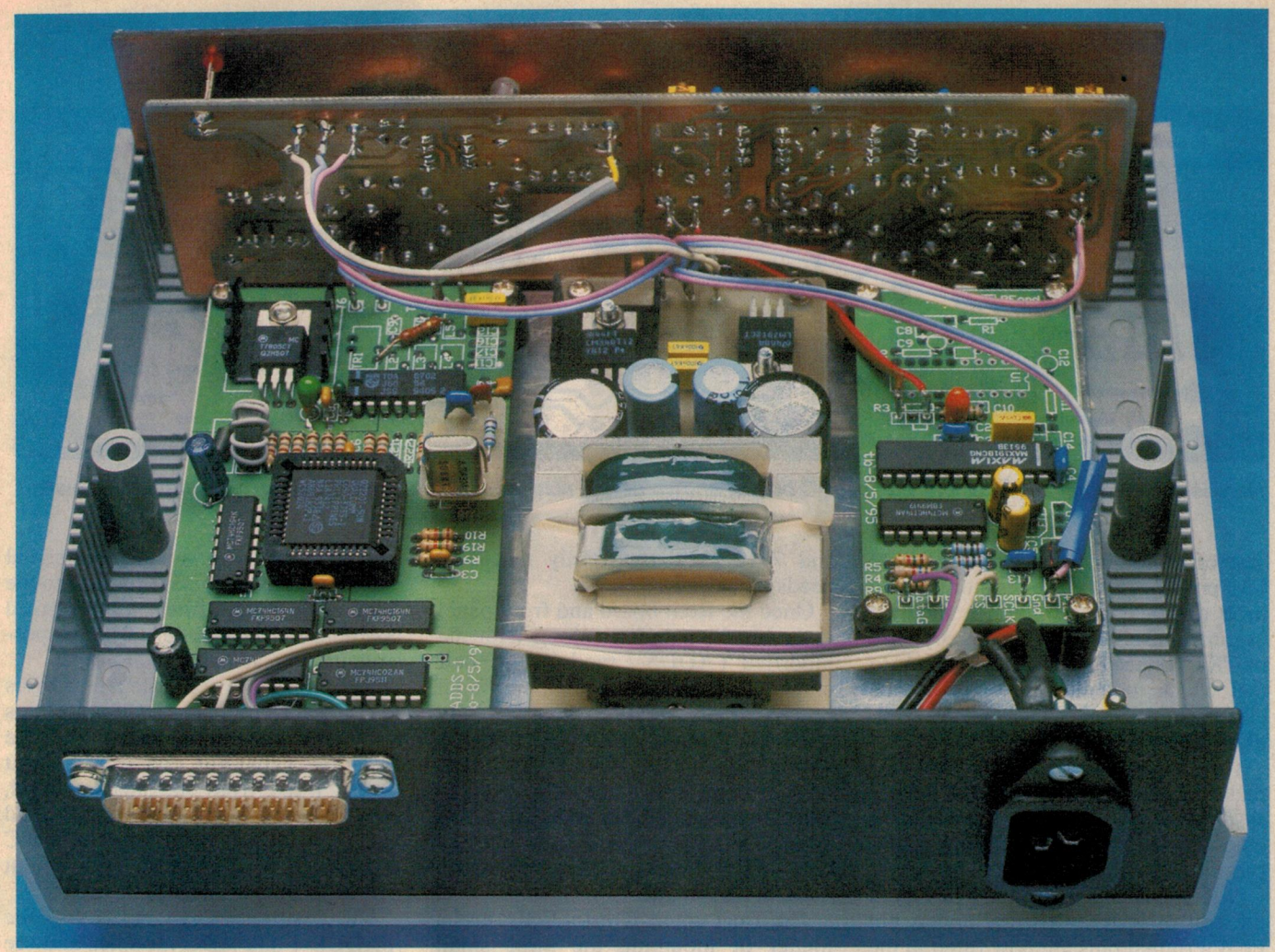
Fit two near R1 for the input to the generator output filter, three julust above R10 for the generator output circuitry supply connections, another three just below RV2 for the analyser supply connections, and finally two just below RV4 for the analyser front-end output connections to the ADC board. All of these pins should be fitted from the copper (rear) side of the board, because the connections are made on that side (see photos).

The reason for having two sets of supply connections to the PCB is that this helps keep generator signals from 'leaking through' into the analyser section. In fact if you look closely at the PCB pattern, you'll see that it's really two separate boards side by side, electrically isolated from one another.

Note that miniature toggle switch SW2 mounts directly on the PCB, with its mounting nuts and washers arranged so that it also helps support the board when it is attached to the front panel. However level pot RV1 mounts only on the front panel, with short lengths of tinned copper wire



A view inside the analyser, showing the way the various boards are arranged. The DDS and ADC boards are mounted horizontally on the shield plate, on either side of the power supply, while the vertical board used for input and output buffering is just behind the front panel.



Another view inside the analyser case, this time looking from the rear to show more detail of the connections between the various boards. Note that a piece of unetched copper laminate is used for the front panel, to provide shielding.

used to extend its three lugs back and mate with the corresponding PCB pads, when the board and panel are combined. The same technique is used for the two BNC connectors.

Apart from the pot and connectors, the only other component which is best NOT mounted initially on the PCB is the LED. It's easiest to leave this until the panel and board are combined, poking its body through the matching hole in the panel (from the rear) just before assembly, and then mating its leads with the PCB holes. Once the panel and PCB are combined the LED leads can then be soldered to the pads with the body neatly protruding from the panel, and then a small dob of glue added at the rear of the panel to hold it securely in place.

The BNC sockets used for the generator output and analyser input are mounted directly on the front panel, of course, again before the PCB and panel are combined.

Then short lengths of tinned copper wire can be used to make the connections to them. In each case, the earthy connection to the socket is also soldered directly to the copper of the unetched PCB laminate panel — which is used to replace the original plastic front panel of the case, as was done with the RF sweeper. The copper laminate is on the inside, so that it provides an earthed ground plane and shield. PCB laminate is easy to drill for the various control and connector holes, etc., and once everything is assembled is quite sturdy.

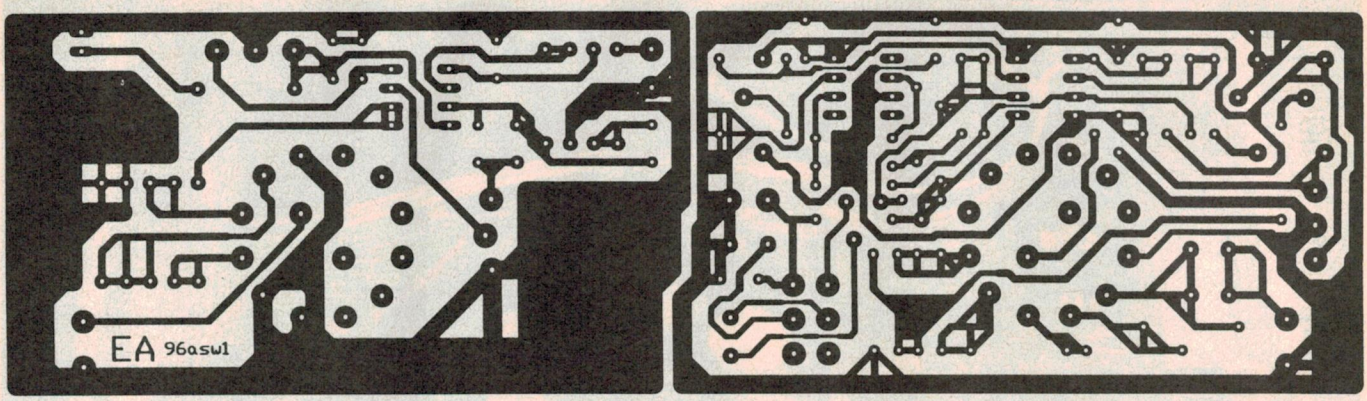
The PCB laminate front panel can be dressed up with an adhesive escutcheon plate made from Dynamark photosensitive aluminium sheet, to give the professional looking instrument shown in the photos. The artwork for the front panel is provided, along with that for the two PCBs.

Like the assembly of the front PCB, that of the little piggyback board for the replacement YADDS-1 module clock oscillator should be quite straightforward if you use the overlay diagrams as a guide.

Note that all of the passive components, including the crystal, go on the top, while U10 the SMD packaged IC mounts on the copper side.

Make sure you use a clean, fine tipped soldering iron to prevent making solder bridges when you solder the IC into circuit, and don't forget to leave both leads of C3, and also the end of R1 connecting to pin 12 of U10, at their full length so that they can be used to make the connections to the YADDS-1 module (and also support the clock PCB itself).

As well as assembling the clock PCB and fitting it to the top of the YADDS-1 module, you'll also need to fit the 220Ω resistor and 3.3nF capacitor to the module, for the first stage of the generator's output filter. They're shown at the left-hand end of Fig.1.



Here is the etching panel for the vertical PC board, shown actual size as usual for those who want to etch their own.

The capacitor is fitted in the original C13 position, while the resistor is fitted in a diagonal fashion, from the pad originally used to take the primary wire of TR1 connecting to pin 14 of U6, to that which took the pin of L5 which connected directly to C13 and the module's output pin.

There are really no modifications to make to the ADC module. It's simply assembled without the log detector chip U1 and all of its associated components (including regulator U4, R11, C12, R3 and C10). The original link at the end of R10 isn't fitted either, but PCB terminal pins are now fitted in the two outer pads of the three, to provide the new input terminals.

The assembly of the dual power supply module won't be described here, because it has already been described separately in the December issue. Note, however that for this project, you'll need to build it with the transformer and regulators to produce +/- 12V DC. In other words, with the 12V+12V transformer and the 7812 and 7912 regulators. Only the 7812 needs a heatsink.

Once the front board and front panel assembly is complete, along with the modified YADDS-1 module, the 'half empty' ADC module and the new dual power supply module, you're ready for the final assembly stage. Assuming, that is, that you've made up the horizontal shield plate and also fitted the DB-25 plug and IEC mains connector to the rear panel. If these are still not done, you may need to do them at this point.

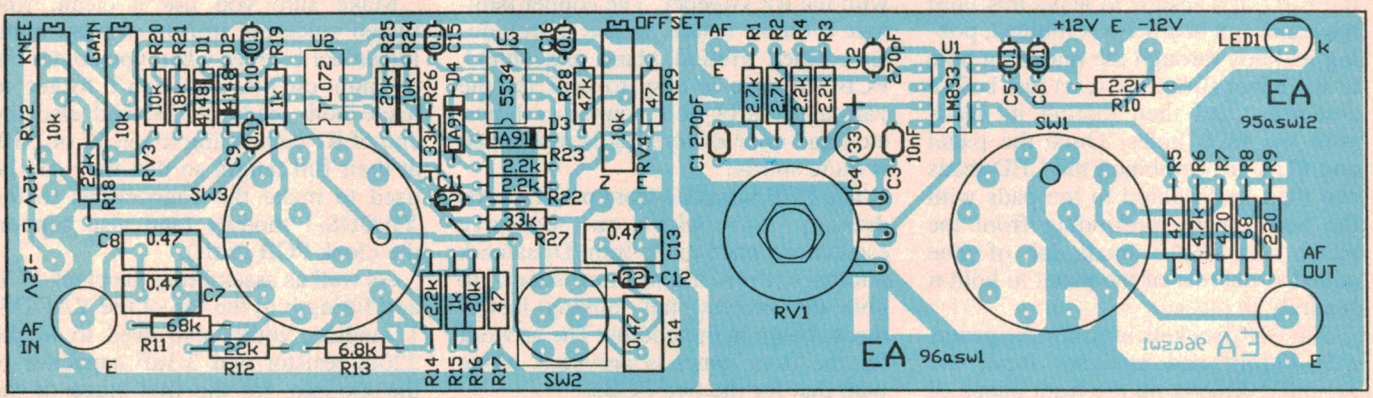
The final stage is essentially just a matter of mounting the three small modules to the shield plate, using 10mm long insulated and tapped spacers, then fitting the completed plate assembly into the bottom of the case, positioning the front and rear panel assemblies near their final positions, and connecting them together.

For most of these connections I used suitable lengths of colour coded light-duty hookup wire, taken from 'rainbow' ribbon cable; the only one I ran in shielded cable was the generator signal lead, from the YADDS-1 module to the input of the output filter on the vertical board, to ensure as little leakage as possible into the analyser section.

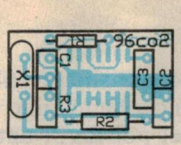
Note that there are quite a few wires to connect to the three DC output pins on the power supply module: three from the generator end of the front board, three from the analyser end, two from the YADDS-1 module and one (to the +12V) from the ADC module. This takes a bit of care, but can be done.

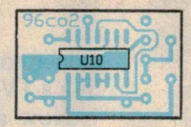
The connections between the YADDS-1 and ADC modules and the DB-25 connector are exactly the same as those used for the RF Sweeper, as described in the October issue on page 78.

Probably the only other off-board wiring that needs special mention are the connections to the IEC captive mains plug. These should all be made in wire with 240V AC rated insulation, and with the correct colour coding: green or yellow/green for the earth

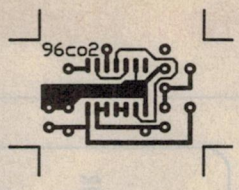


Use this overlay diagram as a guide to wiring up the vertical PC board. Note that the input and output sections of the board are kept electrically separate, and each has its own connections to the power supply.





These top and bottom overlay diagrams for the clock oscillator daughter board show where the leaded components go on the top, and the SMD chip goes on the bottom. Leads from C2 and R1 are used both to support the board and to make the connections to the DDS module.



And here is the etching pattern for the daughter board, again reproduced actual size so that you can etch one yourself if you wish.

lead, brown or red for the active and blue or black for the neutral. Active and neutral connect directly to the terminal block on the power supply module (outer screws), while earth connects to a solder lug attached to the horizontal shield plate.

Don't forget to fit heatshrink sleeving or varnished cambric sleeves over the active and neutral connections to the IEC plug, to prevent accidental shocks.

It's also wise to fit a couple of nylon cable ties to bind the active and neutral wires together, between the plug lugs and the power supply block. This ensures that if one wire should work loose, the other will tend to hold it away from the low-voltage wiring.

Setting it up

When your audio sweeper is fully assembled, check all of the connections between the boards, etc., to make sure everything seems in order (especially the supply connections). Then if all seems OK, try turning on the power and check with your DMM to ensure that the +12V and -12V lines measure correctly on the two halves of the front vertical PCB, as well as the +12V lines on the YADDS-1 and ADC modules.

All going well, connect the sweeper up to your PC's printer port, and run Tibor's DDS.EXE software — setting it for a clock or reference frequency (fr) of 4194.304kHz, and then keying in an output frequency (f) of 1kHz. You should now find that your sweeper's generator is producing a clean 1kHz sinewave, and with its level pot turned fully clockwise and its range switch set to the 0dB position, the output level should be around 1.1V RMS, or 3V p-p.

Now adjust the generator output level to exactly 1V RMS (2.83V p-p), as measured using a calibrated scope or audio millivoltmeter. You'll use this signal shortly, to calibrate the analyser section. Then press the computer's [ESC] key, to exit from the DDS.EXE program (which still leaves the generator running at 1kHz).

Turning now to the analyser, start Tibor's ADC.EXE program — which simply displays the ADC output in decimal form. At this stage you'll get a fairly random number displayed, as none of the preset pots on the vertical PCB is set correctly.

First of all, connect a BNC shorting plug or a 50Ω terminating plug to the analyser input socket, to ensure that there is definitely no AC input. Then if necessary adjust the 'Offset/Linearity' preset pot (RV4) for a reasonable reading, of around 150-200.

Now try adjusting the 'Knee' preset (RV2) one way or the other, to find which direction results in a lower reading. Then continue turning in that direction, and you should reach a definite 'null' or minimum reading. (If the

PARTS LIST

Vertical PCB:

Resistors

All 1/4W 5%, unless specified:

R1,2	2.7k 1% metal film
R3,4,10	2.2k
R5,17,29	47 ohms
R6	4.7k 1% metal film
R7	470 ohms 1% metal film
R8	68 ohms 1% metal film
R9	220 ohms 1% metal film
R11	68k 1% metal film
R12	22k 1% metal film
R13	6.8k 1% metal film
R14,22,23	2.2k 1% metal film
R15	1k 1% metal film
R16,25	20k 1% metal film
R18	22k
R19	1k
R20,24	10k 1% metal film
R21	18k 1% metal film
R26	33k 1% metal film
R27	33k
R28	47k
RV1	10k linear pot
RV2,3,4	10k linear trimpot, 10-turn

Capacitors

C1,2	270pF polystyrene
C3	10nF 100VW MKT
C4	33uF 16VW solid tantalum
C5,6,9,10,15,16	0.1uF 100VW MKT
C7,8,13,14	0.47uF 100VW MKT
C11,12	22nF 100VW MKT

Semiconductors

D1,2	1N4148, 1N914 etc
D3,4	1N60, OA91 or similar
U1	LM833 dual low noise op-amp
U2	TL072 dual FET input op-amp
U3	5534 high speed op-amp
LED1	3mm red LED

Miscellaneous

SW1,3	Single pole 4 pos rotary switch
SW2	DPDT miniature toggle switch
PCB	179 x 51mm, code 96asw1
	10 x PCB terminal pins, tinned copper wire, etc.

Clock PCB:

U10	74HC04 (SMD package)
R1	1/4W resistor (see text)
R2	1M 1/4W 5% resistor
R3	680 ohm 1/4W 5% resistor
C1	68pF NPO ceramic capacitor
C2	47pF NPO ceramic capacitor
C3	0.1uF monolithic capacitor
X1	4.194304MHz crystal

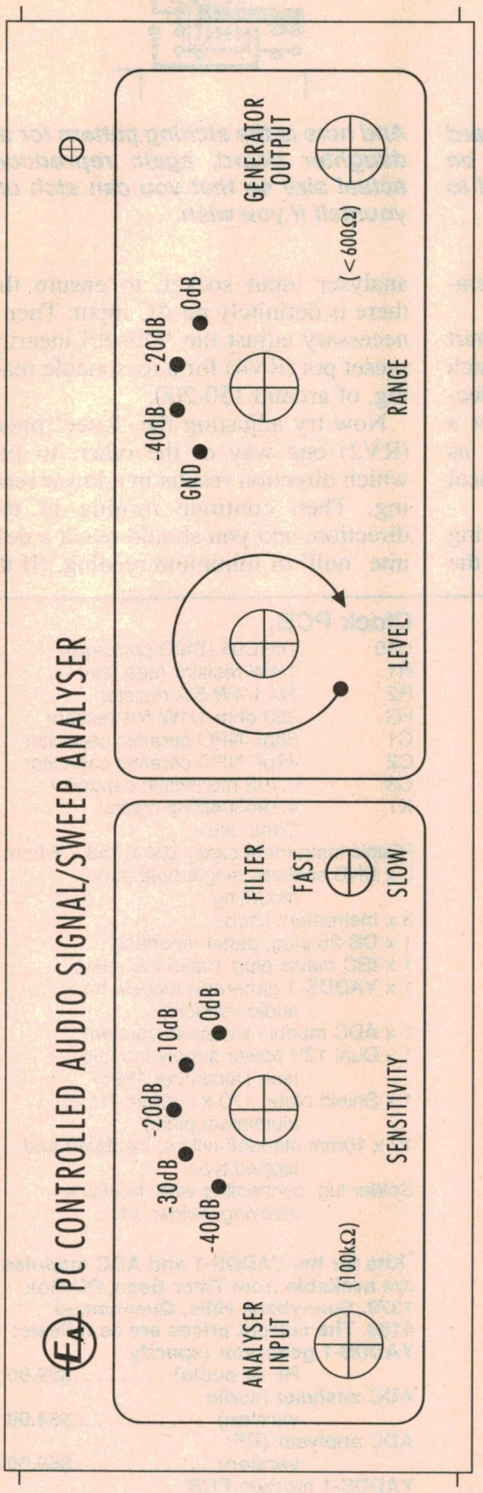
Case, etc:

Plastic instrument case, 204 x 158 x 64mm
2 x BNC sockets, single hole panel mounting
3 x Instrument knobs
1 x DB-25 plug, panel mounting
1 x IEC mains plug, panel mounting
1 x YADDS-1 generator module kit, audio version*
1 x ADC module kit, audio version*
1 x Dual 12V power supply module (see December 1995)
1 x Shield plate, 170 x 120mm (1mm aluminium plate)
12 x 10mm standoff pillars, insulated and tapped type
Solder lug, connecting wire, heatsink sleeving, solder, etc.

***Kits for the YADDS-1 and ADC modules are available from Tibor Bece, PO Box 1379, Sunnybank Hills, Queensland 4109. The current prices are as follows:**

YADDS-1 generator (specify RF or audio) $99.00
ADC analyser (audio version) $64.00
ADC analyser (RF version) $69.00
YADDS-1 module PCB only $25.00
ADC module PCB only $20.00
Please add $5.00 for packaging and postage within Australia.

Mr Bece can now also supply Version 3.02B of his SWEEPER.EXE software on disk, for $49.00 plus $5.00 P&P if purchased separately, or $20 if purchased with the module kits.



Here is the artwork for the analyser front panel, again reproduced actual size to allow photocopying or production of a Dynamark stick-on panel.

reading drops to either zero or a very low level before the null is reached, adjust RV4 to increase the reading again.) The null will be quite sharp, and the idea is to set RV2 exactly at the centre of the null.

With that done, readjust RV4 again so that you're getting a quite low reading — it doesn't have to be zero, just below 20 or so. Then remove the shorting plug from the analyser input, and instead connect a cable between the input and the generator output. Since the generator should still be producing a 1V RMS signal, this will now be fed into the analyser.

Now adjust the 'Gain' preset pot RV3, until you get a reading of 3000. This corresponds to 3V DC at the input to the ADC chip — we set the analyser to produce this level at the ADC for an input level of 1V RMS, so as to give some safe 'headroom' above this reference level (0dBV). As the 'end stop' for the ADC is a DC level of 4.096V, setting the front end gain to produce 3V DC from 1V RMS input gives the analyser the ability to operate linearly to 1.36V RMS, or +2.67dBV. This should be more than adequate for most audio response testing using 1V as the reference.

With RV3 set for a reading of 3000, turn the generator range switch (SW1) down to the -40dB position, to reduce the generator output to 10mV RMS. Now you can adjust the 'Offset/Linearity' preset pot (RV4), to give a reading of 30.

As the gain and offset adjustments are interdependent, it's then a good idea to return the generator range switch to the 0dB setting, and check that the analyser reading returns to 3000. If it doesn't, adjust Gain pot RV3 again until it does; then switch back to the -40dB position and if necessary, tweak RV4 again for a reading of 30. You may have to repeat this process a couple of times, to get the settings correct.

As a final check, try setting the generator switch to the -20dB position. The analyser should give a reading of 300, or very close to it, if everything is set correctly.

Your audio sweep analyser should now be ready for operation. Tibor's DDS.EXE program can be used to set the generator to any desired single frequency, while his LEVEL.EXE program can be used to give analyser level readings directly in dBV (call it by typing '**level lin_adc**', and then pressing [Enter]).

DDS.EXE, ADC.EXE, LEVEL.EXE and other handy drivers are available via the EA Computer BBS, in the compressed file **YADDSDRV.ZIP**. If you can't access the BBS, we can supply the files if you send us a formatted floppy disk and $5 to cover P&P.

Of course for sweeping, Tibor's SWEEPER.EXE program is just the shot. It's very easy to use, very flexible and now has extra facilities like the ability to save screen grabs to disk in .BMP format (to import into DTP packages, print from Windows, etc.), and the ability to save up to eight sweep plots to disk, for later recalling and comparison. You can also set it for logarithmic sweeping instead of linear, and for up to five decades of frequency.

For audio sweeping you call the program by typing '**sweeper audio**', before pressing [Enter]. The 'audio' parameter tells the program to use the correct configuration file (AUDIO.SET), which sets everything up with your last settings for audio sweeping. Once the program fires up, pressing [h] displays the on-screen command menu, and after that everything is fairly intuitive.

The latest version of SWEEPER.EXE is available from Tibor for only $20, if purchased with the modules, or $49 plus $5 P&P if purchased separately. I can warmly commend it, as I've been using it for a while now. It really makes audio sweep analysis a pleasure.

So there you have it — a very neat and professional PC-driven audio sweep analyser, easy to use and capable of making measurements which compare very well with those from equipment costing many thousands of dollars. ❖

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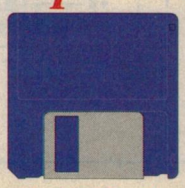

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READER INFO NO. 7

Mini Construction Project:

LOW COST POST CARD FOR YOUR PC

Recently we published one design for a POST test card for PC fault diagnosis, based on an EPLD device. Here's an alternative and lower cost 'low tech' approach, which may well appeal to those who don't have the facilities for programming an EPLD. Actually three different versions are described, offering different levels of circuit complexity and user convenience.

by BARRY HUBBLE

Many people would be aware that their personal computer (PC) does a power on self test (POST) when first switched on — which initialises and tests the various parts of the system (memory chips, disk drives, keyboard, video etc). This project is intended to assist in the diagnosis and repair of PCs using the POST routines, and costing from as little as $20 it is very economical.

If a fault in the system is detected during these test routines the system will, through a series of beeps and/or on-screen messages, attempt to alert the user to the problem. Depending on which Basic Input-Output System (BIOS) is used, these messages can often pinpoint the problem down to the individual chip level, but others leave a lot to be desired with their often cryptic messages. Added to this, if the fault occurs early in the test the BIOS may not be able to produce a message, and will halt the PC without a hint of where the fault may lie.

Fortunately, some BIOS versions send a POST code to an I/O port (usually port 80H) which can be a real advantage in repairing the PC. These codes are used by manufacturers to test systems for faults before they are connected to a monitor, and in most cases are much more informative than the beeps or on-screen messages.

The POST card presented here will display the codes sent to the I/O port, but this information is useless unless you have a list of the codes and their meanings, which unfortunately is different for each BIOS (a pity they didn't standardise on this).

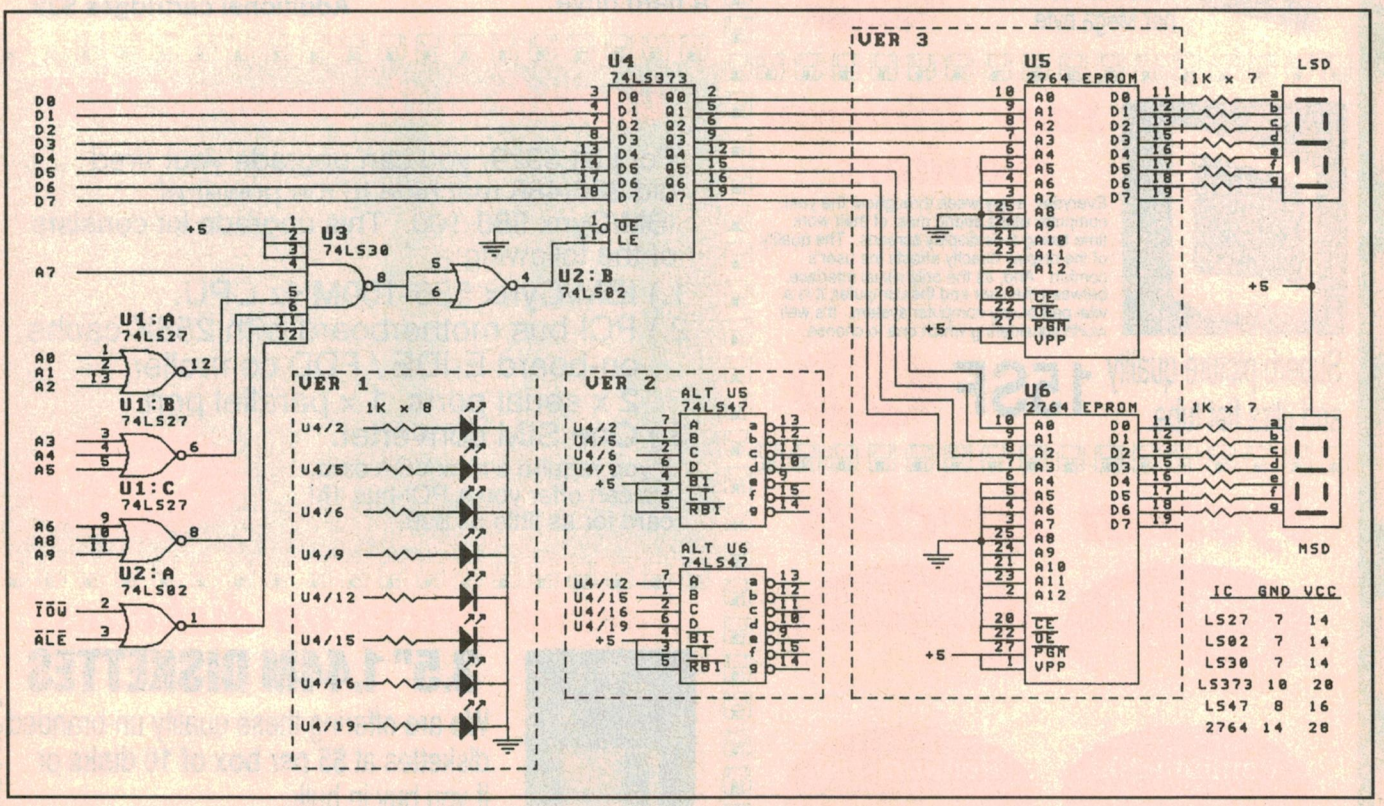

Fig.1: The schematic for all versions.

An excellent reference for owners of PC's with an AMI, Award or Phoenix BIOS, which details these codes is *Upgrading and Repairing PCs*, 2nd edition, by Scott Mueller and published by QUE. I would recommend this manual as a bible for anyone interested in the hardware side of IBM or clone PCs. If the price (I paid $US34.95) is above your budget, you could try your local library, and even if they haven't got it on the shelf they may get it in for you.

I should point out that because ALL the codes associated with the Phoenix BIOS have a corresponding audio code, those owners do not need the hardware card — unless the audio is on the blink!

For owners of systems with other BIOS's (e.g. Compaq, Sharp, IBM, etc) I suggest writing to the distributor/manufacturer of the machine or BIOS supplier, or try to obtain a hardware manual for your particular machine.

The above reference also provides United States addresses for many companies which may help in this respect. If you own an old obscure brand of BIOS (mine was Copam 1983) you could do as I did and upgrade the BIOS to a more modern and recognised brand, and these are available from several firms who specialise in this area.

The POST card comes in three versions to cater for differing budgets, tastes, and facilities available to the constructor. Fig.1 is effectively the schematic for all three versions.

In Version 1 the display consists only of eight light emitting diodes (LEDs) and you must use binary maths to decode it; but it will only cost about $20 to build.

Version 2 is built using 74LS47 decoders and seven-segment LED displays so will cost about $26, but as the decoders do not decode hexadecimal figures properly, a little bit of interpretation is still required.

Finally the deluxe Version 3 gives a proper hexadecimal display but requires access to an EPROM programmer. However at about $38, I feel it is well worth the extra money.

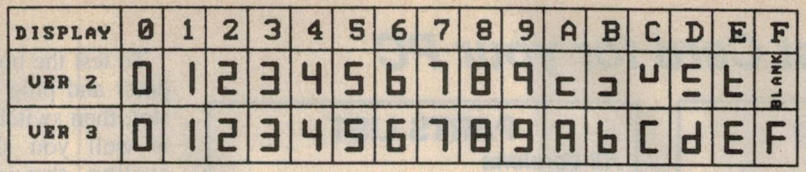

Fig.2: The display readout format for versions 2 and 3.

It may seem a waste that I have used 2764 EPROMs for Version 3, but they were available from an old project (and even if purchased new they are cheaper than the 2708, 2716, 2732 chips!). Actually any old EPROMs you have in the spares box will do as only 16 bytes are required.

USEFUL POST INFORMATION

Readers interested in building this POST card design may be interested in a shareware utility available on the EA Reader Information Service BBS, in the Useful Utilities area. Called PCM105.ZIP, it provides a lot of information on the PC's Power-On Self-Test routine and its diagnostic codes.

The phone number for the EA BBS is (02) 353 0627, and it's normally online for 24 hours a day, seven days a week.

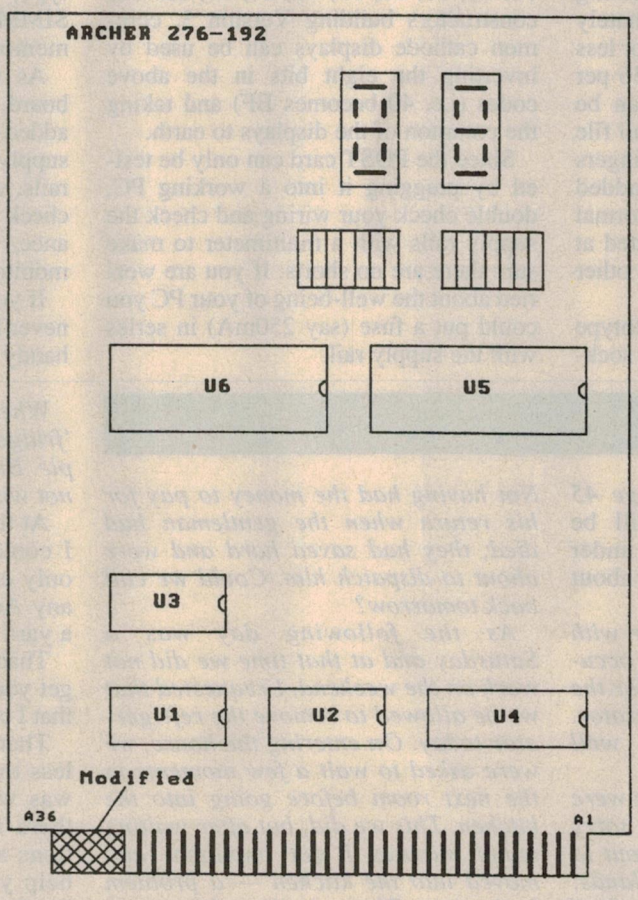

Fig.3: The author's suggested board layout.

The use of EPROMs was made necessary because when I tried to source proper hexadecimal decoder/driver/displays I found the cost to be prohibitive, in fact over $60 each for one brand and they are not readily available.

Fig.2 shows the readouts obtained with versions 2 and 3. All costs are based on point-to-point wiring on a perforated board without the use of sockets.

Address decoding

Referring to the circuit (Fig.1), the PC address lines (A0 - A9) are decoded along with the IOW and ALE signals by NOR gates U1 and U2A, NAND gate U3, and inverted by NOR gate U2B. As shown the address decoded is 80H. Spare gates are available in U2 to invert any address lines to cater for a different port (from Scott Mueller's book we learn that Compaq uses port 84H, IBM PS2/25/30 use port 90H, while some others use port 300H).

The positive pulse produced is applied to the latch enable of the octal latch U4, and while this signal remains high the data on the data bus lines appears at the Q outputs of U4. When the latch enable signal goes low, the data at the Q outputs is latched and will not alter until port 80H is written to again.

For Version 1 the Q outputs of U4 drive eight LEDs via 1k current limiting resistors, to give a binary display of the POST code. In versions 2 and 3 the outputs of U4 are decoded by U5 (least significant digit) and U6 (most significant digit), and these IC's drive the seven-segment displays via 1k resistors. Supply rails to the ICs have not been shown, nor have decoupling capacitors.

A 0.1uF decoupling capacitor should be used on the supply rail to every second chip, and if you build Version 3 a decoupling capacitor should be used on each EPROM. It is also a good idea to provide decoupling at the input to the board of any supply rail you use.

Since the project is fairly simple, construction details have been left up to the individual. However the following notes will be of some assis-

Low cost Post Card for your PC

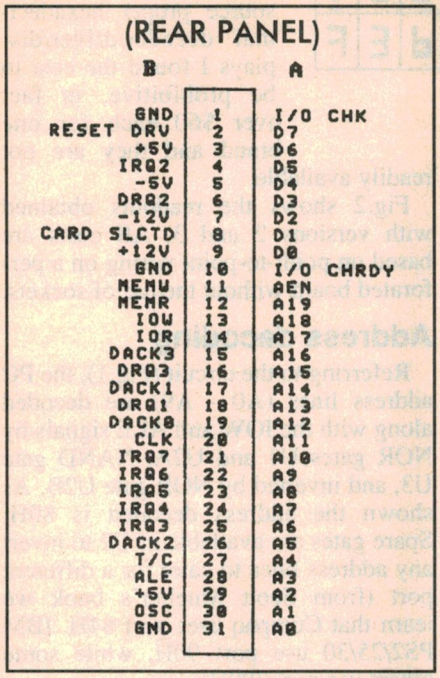

Fig.4: The PC bus connector pinouts.

tance. Perforated prototype boards for PC's are available, but I found that none of these was under $50, and something cheaper had to be used. Fortunately Tandy sell a board (cat 276-192) for less than $10 which has a 72-finger (36 per side) edge connector, and this can be modified using a hacksaw and small file to cut the connector down to 31 fingers per side. This board has the added advantage that it is taller than a normal board, and with the display mounted at the top it is clearly visible above other boards in the system.

I used wire wrapping for the prototype to test different ideas, but as these sockets are more expensive than the chips you put in them I suggest point-to-point wiring for economy. A suggested layout is included (Fig.3), but there is ample room on the board for any layout you desire. Pinouts for the PC bus connector are shown in Fig.4.

The code to be programmed into the EPROMs, starting at address 0, is (all values in hex): 40, 79, 24, 30, 19, 12, 02, 78, 00, 10, 08, 03, 46, 21, 06, 0E. For constructors building Version 3, common cathode displays can be used by inverting the eight bits in the above codes (i.e. 40 becomes BF) and taking the common of the displays to earth.

Since the POST card can only be tested by plugging it into a working PC, double check your wiring and check the supply rails with a multimeter to make sure there are no shorts. If you are worried about the well-being of your PC you could put a fuse (say 250mA) in series with the supply rail.

PARTS LIST

All Versions

1 Perf board, 'Archer' 276-192
1 74LS27 triple three input NOR gate
1 74LS02 quad two input NOR gate
1 74LS30 eight input NAND gate
1 74LS373 octal tri-state D type latch

Version 1 only

8 1k 0.25W resistors
8 5mm red LEDs

Versions 2 and 3

2 Common anode 7-segment LED displays
14 1k 0.25W resistors

Version 2 only

2 74LS47 BCD to 7-seg decoder driver

Version 3 only

2 2764 EPROMs (see text)

To test the board, switch off the computer and plug the board into a vacant slot, then switch the computer on. If all is well you should see the display cycling through the codes as the machine boots up. If not, switch off VERY FAST and recheck all components and wiring...

After a successful boot up with the card installed, it can be checked for correct operation using the DEBUG program's assemble command to write a small program, and the proceed command to step through it:

```
C\>debug
_a                          <return>
xxxx:0100 mov al,0          <return>
xxxx:0102 out 80,al         <return>
xxxx:0104 inc al            <return>
xxxx:0106 jmp 102           <return>
xxxx:0108                   <return>
_p                          <return>
```

When you are satisfied that the board is working correctly, you may wish to experiment with some simulated faults. Non-destructive faults could include unplugging the keyboard, removing the power and/or data cables from a disk drive, removing the video card — and if you are the adventurous type, removing a memory chip or SIMM module from a high or low memory bank.

As there is plenty of room on the board, some enhancements could be added such as test points to measure the supply rails, LEDs to monitor the supply rails, voltage comparators with LEDs to check that the supply rails are in tolerance, buffers with pulse stretchers to monitor selected signals, etc.

If you build the POST card I hope you never have to use it. But at the price, it's handy to have just in case! ❖

THE SERVICEMAN

Continued from page 45

name yet, but no doubt I will be advised eventually. He writes under the heading 'You wouldn't read about it!', as follows...

The story starts as I, together with an employee, approach a house occupied by some 'country cousins' for the purpose of repossessing a refrigerator. The people concerned were well behind with their HP payments.

On approaching the house, we were met by a large crowd of very sorry looking people — they were about to send their relative back to the Islands.

The relative, it so happens, was dead and had been for about four weeks. Not having had the money to pay for his return when the gentleman had died, they had saved hard and were about to dispatch him. Could we call back tomorrow?

As the following day was a Saturday and at that time we did not work on the weekend, I requested that we be allowed to remove the refrigerator today. On entering the house, we were asked to wait a few moments in the next room before going into the kitchen. This we did, but after waiting many minutes I got impatient and moved into the kitchen — a problem had arisen. There, in the refrigerator, was the body of the deceased.

When it had first been placed in the 'fridge, the body had been quite supple. But now it was rock hard, and did not wish to be extracted!

At the risk of being branded 'racist', I contend that a story like that could only come from New Zealand! Could any Australian possibly come up with a yarn to equal that one?

Thanks anyway, 'Arnold'. I hope to get your full name and address soon, so that I can send you your contributors fee.

That's all for this month. A little bit less than usual but I think the quality was well up to standard. Remember, there is always a place for contributions and I'll bend over backwards to help you get a good story into shape for the column. Get in touch.

Bye, until next month. ❖

Experimenting with Electronics

by DARREN YATES, B. Sc.

Op-amps IV — some unusual circuits

This month, to round out our look at op-amps for the time being, we uncover some unusual circuits which use op-amps in unexpected situations, with great effect.

Having looked over some of the circuits I've read about and used over the last seven years or so, it's clear that it's very difficult to design something completely new. Most circuits are just variations on one theme or another; but every now and then, you come across a circuit idea that can be used in many situations — plus a few which you won't find in the textbooks.

Now while some of these circuits will be familiar to experienced experimenters, and have been used often before, those who are new to electronics may have only seen them within larger circuits. And since most big circuits are just little circuits joined together, these little 'odds and ends' are worth storing away in the notebook.

Supply rail splitter

The first of these is only recommended for battery operation and is shown in Fig.1. In months passed, we've talked about the problems found with dual-rail versus single-rail circuits — the need to worry about two power supplies and making sure each side is kept separate.

While single rail supplies are good, there are some circuits which often operate more simply with two rails instead of one.

Fig.1 looks simple enough, but it can be a little confusing. You take an op-amp, bias the non-inverting input to half the battery voltage, connect the op-amp as a non-inverting buffer, and there you have it — a dual rail supply. So how does it work, and more important, what's the point of it?

Let's answer the second question first. This circuit turns any 9V battery into a +/-4.5V dual supply with a centre or 0V level at ground potential. It won't handle a 100W amplifier, but it will handle around 20mA of current without too many worries — more than enough for most op-amp circuits. You don't lose any battery voltage — the circuit still has its full 9V from rail to rail, and most op-amp circuits will operate just the same in this mode.

What it does is often simplify the rest of the circuit, especially in terms of voltage biasing.

Now that we have a centre ground, you can connect the inputs to ground rather than having to bias them with two resistors. Either way the input is biased to half way between the two supply rails, except that with this splitter circuit in place, you don't need two resistors for every bias point.

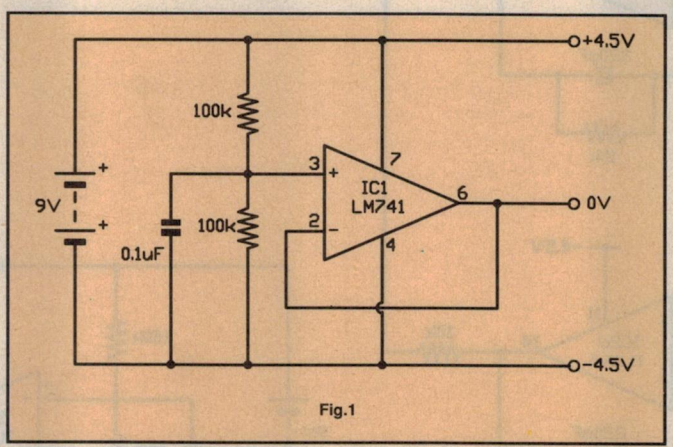

Fig.1

To answer the first question, the op-amp simply creates a low impedance 'artificial ground', which can handle up to 20mA from either supply.

This circuit should only be used on battery-operated circuits because the artificial ground of the circuit, if used with other circuitry, forces the ground of the transformer or plug pack below 0V — a potentially hazardous situation.

Battery powered mixer

Fig.2 shows a simple example of where this circuit comes in handy. The circuit shows a battery-powered four-channel audio mixer. IC1b is connected up as the supply rail splitter and its artificial ground is used as the bias point for each non-inverting input of IC2 and IC1a. By replacing the biasing components by each pot, which we would still need anyway, we save about 10 or so resistors.

The pot not only allows us to control the audio but it also supplies the bias required for each op-amp. You may have noticed an extra resistor connected to each non-inverting input. These are called blocking resistors, and reduce the op-amps' sensitivity to RF interference. The last thing you need when you're recording your next masterpiece is a 'late scratching — Dapto' or similar message coming from a local radio station.

Good audio design rules would dictate that we should isolate DC from the pot. As a result, the pots would last longer and you won't get the crackle problem as severely. However, the current flow here is quite tiny due to the high input impedance of the op-amp.

The extra bonus is that it can be all done with just two ICs. The spare op-amp in the TL062 package is used for the supply splitter, so no components are left going to waste. You don't need to worry about the supplies when the battery begins to weaken, as both supplies maintain the same voltage magnitude.

Incidentally, this is the best way to design a simple mixer. Many more crude circuits simply take the input, feed

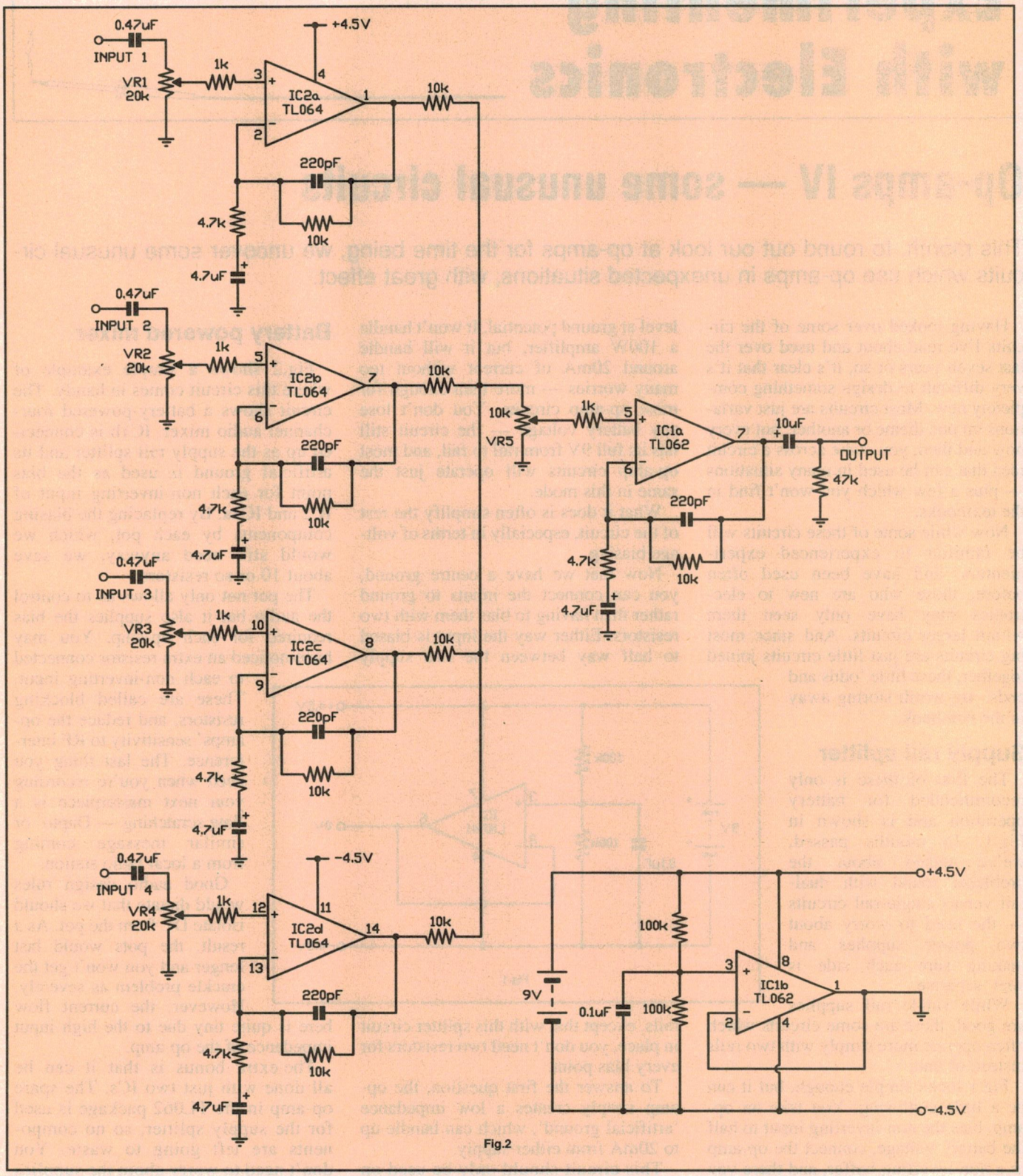

Fig.2

it through mixing resistors and then take the output from the junction. While this does work, you suffer greatly from the problem of interaction between the pots upsetting levels from other inputs. Because each input in this circuit has its own op-amp, each input control is effectively isolated from the others, ensuring that you don't have all levels changing by adjusting one of the input controls.

Inductor replacement

Another area where op-amps have made a mark is in the area of component replacements. In days gone by, many graphic equalisers used inductors as part

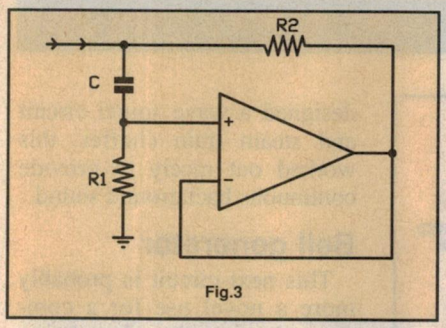

Fig.3

of the circuit elements. The problem is that inductors, particularly high value units, are quite large and when you have to fit 10 to 20 inside a box, it starts to become a tight squeeze. They're also pretty expensive to make.

These days, most commercial graphic equalisers don't use them. Instead they use a circuit commonly called a *gyrator*, which effectively turns a capacitor into an inductor.

The main characteristic of an inductor in terms of an AC signal is that the voltage phase leads the current by 90°. What happens is that the circuit delays the travel of current. The capacitor's characteristics are the exact opposite — i.e., the current leads the voltage.

What the op-amp does in this circuit is to change the phase of the current through the capacitor for a given signal voltage.

As you can see from Fig.3, the op-amp itself is simply connected up as a voltage follower, but the real work is done in conjunction with the two resistors and capacitor.

If we apply a signal to the input of the circuit, a current flows through the capacitor and resistor R1. Because we have a current flowing through resistor R1, it also has a voltage across it and this voltage is fed into the non-inverting input of the op-amp.

The output of this op-amp is a low impedance copy of the input, but this is fed via resistor R2 back to the input capacitor. What happens now is a bit of complex mathematics, as the two signals are added together. Since we're talking about AC signals, it's not just a case of simple addition and this is where the phase comes into play. The signal isn't taken from the output of the op-amp, but rather it's the same point as the input signal!

Looking at Fig.4, this is the classical equaliser circuit using a grounded inductor. Here only one end of the inductor is connected to the circuit proper. The capacitor and inductor here form a tuned circuit, in a similar way as they would for selecting a radio station in your FM or AM radio. Depending on the position of the 50kΩ pot, the signal is either boosted or reduced by the amplification provided by the op-amp. With the pot in the centre, the op-amp provides unity gain at the frequency of the tuned circuit, so all frequencies are fed through at the same amplitude. If the pot is wound to the left (upwards as shown in the circuit), the signal is filtered off at that particular frequency. Wound in the other direction, that particular frequency component in the signal is boosted.

The op-amp, resistors and capacitor of Fig.3 simply emulate the grounded inductor. What is quite simple is the equation to work out the inductance:

$L = R1 \times R2 \times C$

where R1 and R2 are the value of the resistors in ohms and C, the value of the capacitor in farads. Nice and easy.

Fig.5 shows us a practical circuit example combining two separate channels, one (IC1c) tuned at 400Hz and the other (IC1d) at 4kHz. Mind you, it wouldn't take too much to adjust them to any frequency you desired.

The circuit uses just one IC which makes it nice and easy to build as well. IC1a is connected up as a simple buffer so as not to load down the previous stage. It then feeds the signal to both equaliser sections, incorporating our gyrators, IC1c and d. The filtered signal is then amplified by IC1b.

As you'd probably expect by now, a gyrator is not the *perfect* replacement for an inductor. The problem lies in the fact that the op-amp has to able to amplify the input frequency — and since most op-amps have a top speed of around

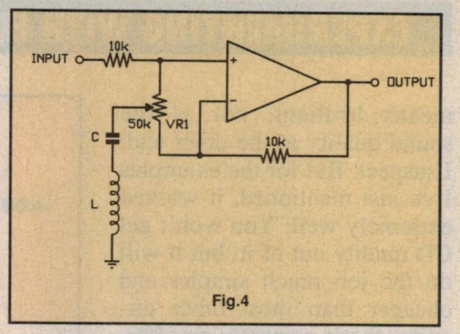

Fig.4

10MHz at best, you'll more likely than not find that the circuit stops working at around 3 - 4MHz. Be that as it may, an AM radio using this circuit for tuning is still an interesting possibility...

Amplitude modulator

Speaking of AM, most op-amps have no simple way of electronically adjusting the gain, in either non-inverting or inverting mode. However, add a couple of capacitors and a diode and you can achieve a reasonable degree of control using a variable DC voltage. The benefit here is that you're no longer tied to having someone turn a volume control to adjust the gain. You could for example, use a remote control to generate a DC voltage which controls the volume. You could also program a PC to do the same thing.

Now while I don't propose to dip into the PC world at this stage, the circuit for a useful amplitude modulator is shown in Fig.6. You can use this circuit as a basis for a very realistic steam train 'chuff-chuff' simulator, or even synthesise the waves crashing onto your favourite beach...

The linearity of the control is by no

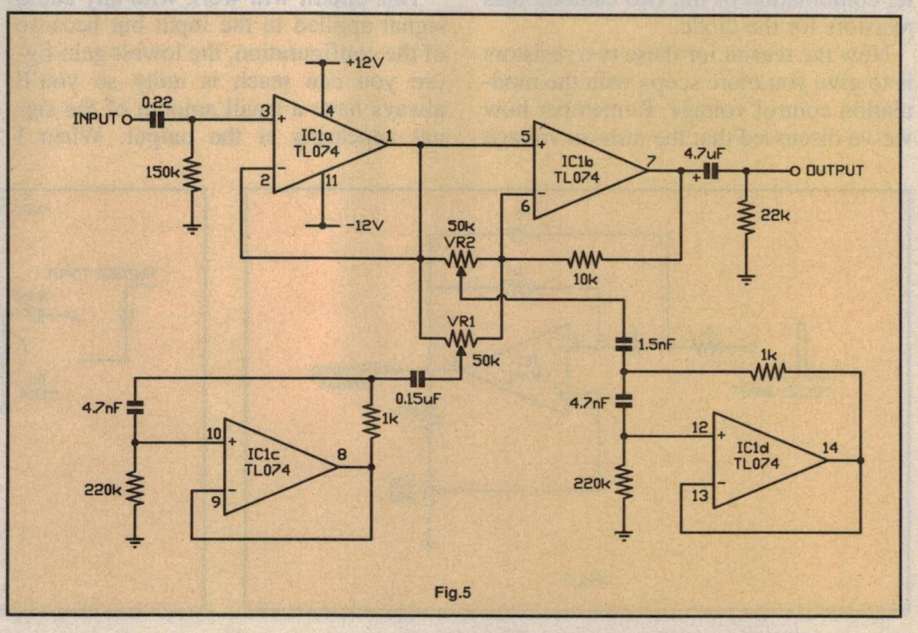

Fig.5

means brilliant, nor is the sound quality at the other end, I suspect. But for the examples I've just mentioned, it worked extremely well. You won't get CD quality out of it, but it will do the job much simpler and cheaper than most other circuitry that's currently on offer.

Looking at Fig.6, we use the diode as a voltage controlled resistor. As the diode conducts, its resistance drops and the gain of the op-amp circuit rises. Drop the control voltage, the diode's resistance increases and the op-amp gain decreases.

The trick is to remember that diodes don't instantly switch on when the anode is 0.6V higher than the cathode. A diode's resistance, or more correctly its *impedance* begins to drop even with just 0.1V between anode and cathode. The more voltage, the faster the rate of decrease in the impedance. By the time you reach 0.6V, the impedance has dropped to a very low value — low enough to cause most signal diodes to blow up if not current-protected.

In this circuit, the maximum gain occurs when the diode is fully on. At the moment, it works out to be the 100kΩ feedback resistor divided by the impedance of the diode, since the cathode of the diode is shunted to ground via a 0.22uF capacitor. If you remove this capacitor, the gain drops down to around three — or 100kΩ divided by the parallel combination of the two cathode bias resistors for the diode.

Now the reason for these two resistors is to give you more scope with the modulation control voltage. Remember how we've discussed that the turn-on voltage for the diode is 0.6V? Most circuits generate much higher voltages, so by including this biasing arrangement, the control voltage must rise to 0.6V above the cathode bias voltage to make sure the diode turns on hard.

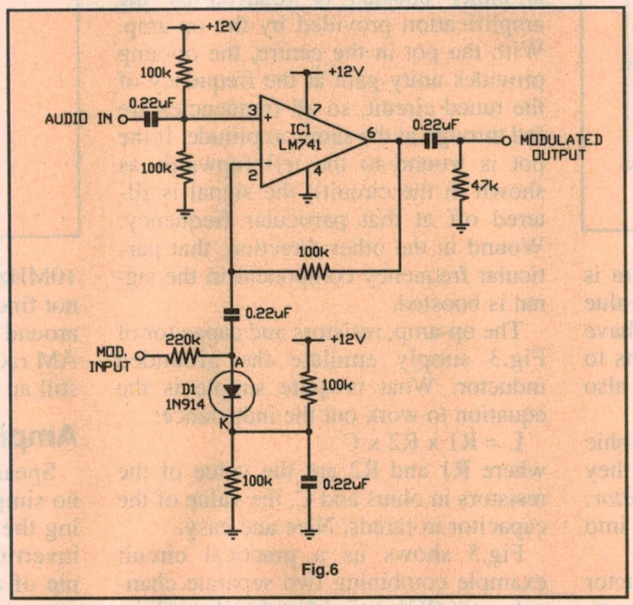

Fig.6

There's no hard and fast rule with this biasing arrangement — you can change it about to your heart's content. But remember the control voltage will need to get above the bias voltage by more than 0.6V in order to work. The capacitor above the diode in the circuit isolates the DC flow, so it doesn't matter all that much what control voltage your using, within reason of course — I'd use a limit of about 15V to be safe, though.

This circuit will work with any audio signal applied to the input but because of the configuration, the lowest gain figure you can reach is unity so you'll always have a small amount of the signal appearing at the output. When I designed a wave sound circuit and steam train chuffer, this worked out nicely to provide continuous background sound.

Bell generator

This next circuit is probably more a novel use for a common circuit rather than being unusual, and it can be used as the basis for an electronic doorbell (one that actually sounds like a bell!).

Looking at the circuit in Fig.7, it uses a common LM741 op-amp in a configuration called a *multiple feedback bandpass filter*. The name itself probably requires a little explanation. It's 'multiple' because it not only has two negative feedback paths — one via the 1MΩ resistor and the other via the capacitor — but it also has a positive feedback path as well.

The term 'bandpass' refers to what type of frequency response the circuit has. When a circuit is described as being a bandpass filter, it usually means that the circuit will allow only a small range of frequencies to pass through and block all others off.

If the components are 'tuned' correctly, it's possible to make the frequency band very narrow. With any set of components, there will be a resonant frequency, or frequency at which the circuit is best tuned. By controlling the amount of positive feedback, we can make this point more and more sensitive or 'sharply tuned'. The measure of this tuning sharpness or *selectivity* is called the 'Q' of the circuit. A more exact definition of this term can be found in most electronic course texts.

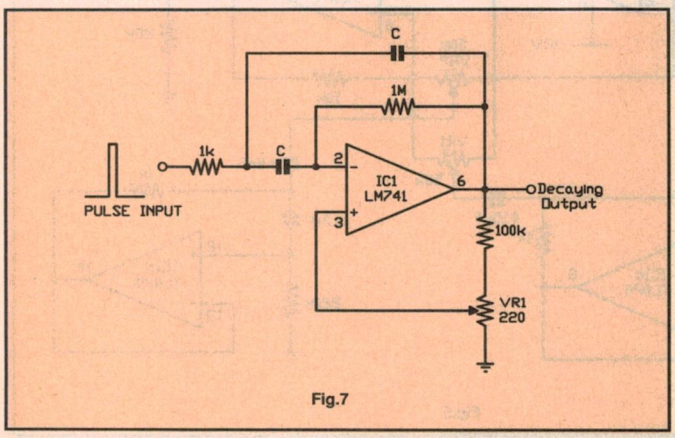

Fig.7

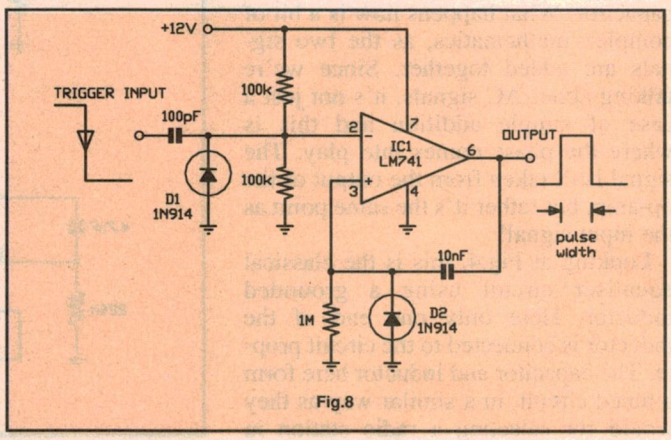

Fig.8

Then, some clever bloke discovered that if you hit the input with a short pulse, you can make the circuit resonate at the tuned frequency. By adjusting the Q, which you do by changing the pot VR1, the decay of the oscillation lasts longer and longer. Of course, wind it too far and it never decays!

By adjusting the resonant frequency, you can either make a bell clang or, at a lower frequency, a more percussive woodblock sound.

You can work out the frequency from the following equation:

F= 1 / (185,000 x C)

where C is the value in farads of the two capacitors. Note the capacitors must be the same value.

Monostable multi

This circuit is one you can add to your 'I need a (insert circuit required) but I've only got one op-amp left' file. Monostable multivibrators or 'monostables' are useful circuits which can be made to provide a fixed length pulse. They can be used in everything from alarm to video circuitry, and are pretty handy to have around.

The op-amp can be made to work as a monostable without too many problems, and a typical circuit is shown in Fig.8.

Looking at the circuit, you can see that it's neatly divided into two areas. The inverting input and associated components handle the input pulse signal, while the non-inverting input and its components handle the fixed-length pulse timing.

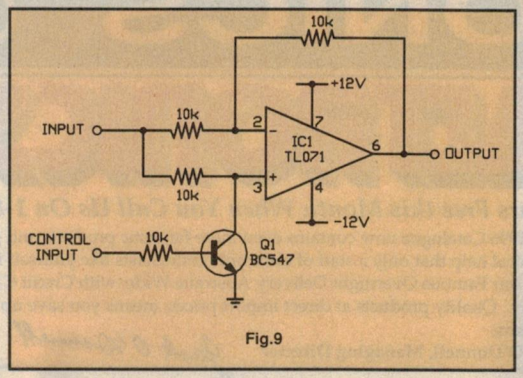

Fig.9

When a negative-going pulse of any length is received at the input, the 100pF capacitor allows the pulse to flow through to the inverting input. For a short time, the inverting input is lower in voltage than the non-inverting input. The output now swings high, and begins to charge up the 10nF capacitor via the 1MΩ resistor.

Initially, when the capacitor first begins to charge, the non-inverting input is high — which keeps the output high and the capacitor charging. But as it charges, the non-inverting input voltage is falling and once it reaches the bias voltage on the inverting input, the output falls low and the capacitor discharges. Since there is nothing in the circuit to pull it high again, the output stays low until the next negative-going pulse arrives.

The only difficulty with this circuit is that the length of the pulse is mainly determined by the op-amp, the 10nF capacitor and the 1MΩ resistor. Increasing either the capacitor or resistor will result in a longer output pulse. The output pulse length in this circuit should be about 10ms, or at least in that order of magnitude.

Plus or minus?

Our last circuit for this month doesn't have any specific purpose in particular — it's just a very easy way to switch an op-amp between unity non-inverting gain and unity inverting gain. The circuit is shown in Fig.9.

It's all controlled by the switch input at point A. If this input is high, Q1 is turned on and the non-inverting input is shunted to ground, leaving the op-amp to work as an inverting amp with a gain of -1. If we now pull the control input low, the transistor turns off and the gain reverts to +1. Nice and easy, but well worth having in your circuit clipbook.

One area where you could use this quite effectively is as a phase reverser for audio signals. If you suspect your speakers may be wired up out of phase, slip this circuit in the preamp audio path and you'll soon find out what's going on. The transistor is a BC547 type, but you could just about use any NPN type you have lying around in your junkbox or parts bin.

Next month, we'll look at the 555 timer IC and see how this special purpose IC is not quite so 'special purpose' after all. ❖

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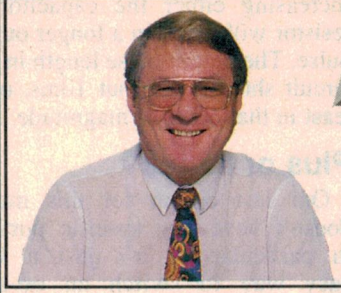

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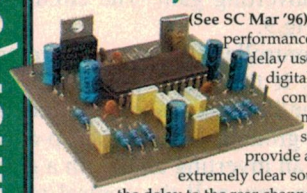

(See SC Mar '96) This high performance 20ms delay uses the latest digital conversion and memory storage IC to provide an extremely clear sound. Add the delay to the rear channel of a low-cost surround sound decoder for a professional sounding A-V system, or add the delay to your PA system to eliminate echo from the front. Requires 12V DC power supply (not included).

K 5595 **$39.95**

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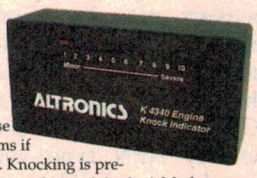

(See SC April '96) With the reduction of lead levels in super-grade petrol, engine knock can cause serious problems if left unchecked. Knocking is pre-ignition, pre-detonation, or 'pinging'. Modern cars have electronic engine management systems which can account for this as it occurs, but for less sophisticated motors, the knock sensor will indicate the occurrence and severity of the knocking on an LED bargraph.

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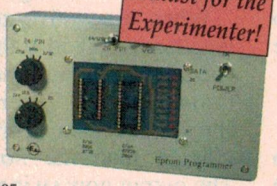

(See EA Sept '93) This is a great new kit for programming EPROM's from 2716 to 27256. Compares favourably against commercial units costing $$$ more. This kit puts you in the driving seat for under $100. It is flexible enough to be able to program 12.5, 21 and 25V EPROM's/EEPROM's.

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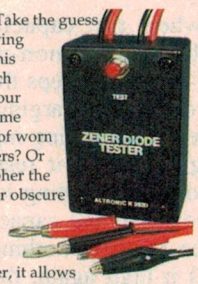

(See ETI May '83) Take the guess work out of identifying zener diodes with this handy adaptor which simply plugs into your multimeter. Ever come across the problem of worn off marking on zeners? Or even trying to decipher the 1N4XXX numbers or obscure manufacturers markings? By plugging this tester into your multimeter, it allows you to read the actual zener voltage of any zener diode up to 60 volts and will also test LED's as well as give you a reading of the forward voltage drop. Requires a 9V battery (not included).

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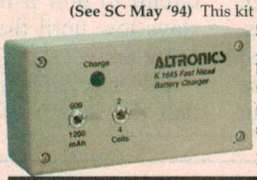

(See SC May '94) This kit will allow you to charge your nicads in a very short time. 50 minutes for 600Ah 'AA' and about 100 Minutes for 1.2 AH 'C' & 'D' cells. It can be powered from your car battery, or any other 12V DC source. Can be configured to charge 2 or 4 batteries at a time. Includes a built-in timer circuit to prevent over charging and utilises a switching controller to create a high efficiency charge.

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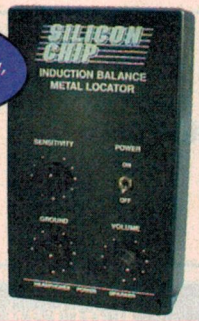

(See SC May '94) What a great kit. This is a simple to build metal detector. It is suitable for wet & dry ground, includes adjustments to eliminate ground effects, has a sensitivity control and audible indicator. It can detect a small metal objects such as a coin at a distance of about 20cm. Please note this kit is supplied in short form. i.e. does not include PVC piping (standard electrical or plumbing pipe available from hardware stores) nor the plastic plate for the coils.

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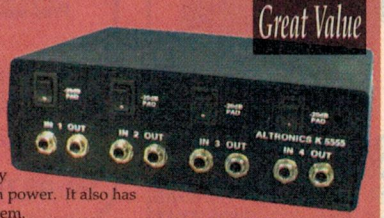

(See EA Oct '87) This single DI box is made for rough treatment. The full metal jacket ensures no interference and extends it's life. With professionally printed front panel, your friends wont believe you built it yourself. This DI box has the flexibility of running on a 9V battery or phantom power. It also has a 15dB pad and a unique earthing system.

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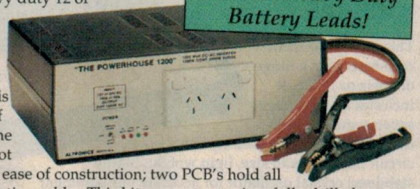

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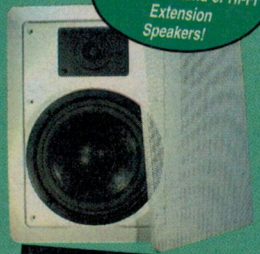

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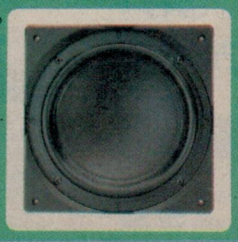

Specifications: • **Impedance:** 8 Ohm • **Power Input:** 20W RMS, 100W Max. • **Frequency Response:** 30Hz - 150Hz • **Colour:** Ivory White • **Dimensions:** 255L x 255W x 85H mm

C 0875 **$120** each

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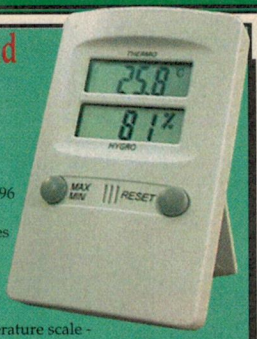

Of the many new items evaluated by our lab for the 1996 product range, none impressed us more than this fine German designed thermometer / hygrometer. Features simultaneous display of both temperature and humidity on an easy-to-read 12mm LCD digital readout. Enables storage and recall of maximum and minimum temperature and humidity readings reached, which are held in memory until reset. Temperature scale - 15°C to +49.9°C. Humidity range 30% to 90% ±3% accuracy. Includes tilting bail for desk mounting, or can be wall mounted as desired.
Excellent for monitoring air conditioning systems, wine cellars, hot houses, computer rooms and the weather.

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Incredibly Versatile Piece of Test Gear! Three Instruments in One!

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Check Insulation Breakdown in Electrical Appliances, Wiring, Alternator & Motor Windings, Transformers etc!

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Effective Range:	0 - 100MΩ
Accuracy:	Within 7% of indicated value on effective scale
Terminal Voltage:	Rated V / Rated R = 500V / 100MΩ
Battery:	1.5V AA Cell

Q 1240 **$95**

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Q 1051 **$29.95**

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Includes Bonus Temperature Probe!

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T 2108	T-07	1.9
T 2108	T-08	2.3
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T 2115	T-15	3.3

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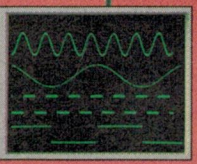
Q 0175 Cro Probes to Suit $39.95 Each

Highly recommended for the service bench, design laboratory, manufacturers, universities and the dedicated enthusiast.

New Model Features Simultaneous display of original and magnified waveforms, both traces shown.



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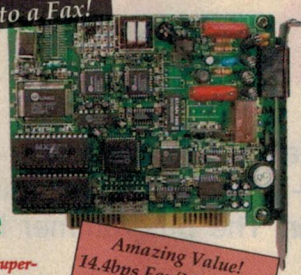

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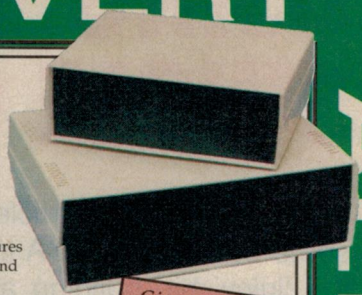

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Features: • microprocessor controlled • 8 fully programmable supervised zones • supervised fire zone • 1 auxiliary normally open zone • 3 keypad activated zones • two master codes, one installer code and 16 user codes • monitor function which tests features like battery backup and mains failure • eight individually and fully programmable zones with a large array of functions available • all eight sectors utilise extensive noise protection circuitry and end of line resistors for added security • once triggered, the alarm has the option of a silent alarm, and dialling a friend or monitoring company • quick arming option • zone bypassing for sectors which are false triggering • bell test - to test the external sirens without dialling out • door chime mode for entry/exit paths • battery backup • home or away operation • accessible alarm memory for confirming which sectors were triggered • separate instruction and installation manuals • 12 months warranty • system information can be downloaded to a printer

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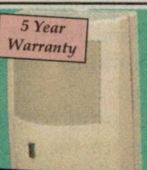

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USING THE PIC16C84 SINGLE CHIP MICRO - 2

In the first of these articles, we introduced the PIC16C84 miniature microcontroller and described some of its features. A lot of that was dry — but important — groundwork. We can now get into the 'juicy' bit, building and using the PC-driven programmer. The programmer has been purposefully designed to be reliable, cheap and easy to build.

by CHARLES MANNING

Once you have developed some PIC software, you need to program or, to use the lingo, 'burn' it into the microcontroller's program memory. This is typically done from a host computer via a programming interface, or just 'programmer'.

The programmer described here attaches to the printer port of an IBM compatible PC, which means that it does not require any special interface cards. It can even be used with a notebook computer to make a fully portable development system.

Microchip added a new five-pin serial programming mode to the new 14-bit series of PIC chips. Previous PIC versions only supported a 17-pin parallel programming mode. The serial programming mode has two major benefits over the parallel mode: it allows in-circuit programming and, more importantly to us, reduces the complexity of the programming interface. This programmer only uses serial mode as there is no real benefit in supporting both serial and parallel modes.

Microchip also made a big move from their previous policies by making their programming specifications public. Before this they only gave out this information under a strict non-disclosure agreement.

The serial programming mode requires just five connections to the PIC. These are power (nominally 5V), ground, Vpp (12 to 14V), clock (RB6) and data (RB7).

The PIC enters programming mode when the Vpp pin rises sharply from zero to the programming voltage while the clock and data lines are held low. The PIC then remains in programming mode until it is reset by taking the Vpp pin to zero volts.

Serial data is transferred to and from the PIC via the data pin, RB7. The data transfer is controlled by sending clocking signals to the clock pin, RB6. When accepting data, the PIC latches the data on the falling edge (high to low transition) of the clock pin. When outputting data, the PIC increments to the next bit on the rising edge (low to high transition) of the clock pin.

The PIC 16C84 programming logic is controlled by eight commands, seven of which are useful for serial programming. The eighth command is used to enter parallel programming mode and is not used by this programmer. Each of these commands is made up of a six-bit sequence which is written to the PIC to select the desired action.

Most of these commands are followed by a data transfer operation, either into or out of the PIC. Data transfers are always 16 bits wide, though the effective data transfer is either 14 or eight bits wide, for program and EEPROM data transfers respectively. The control command set for the 16C84 is different from other PICs as it also supports writing and reading of the EEPROM data memory.

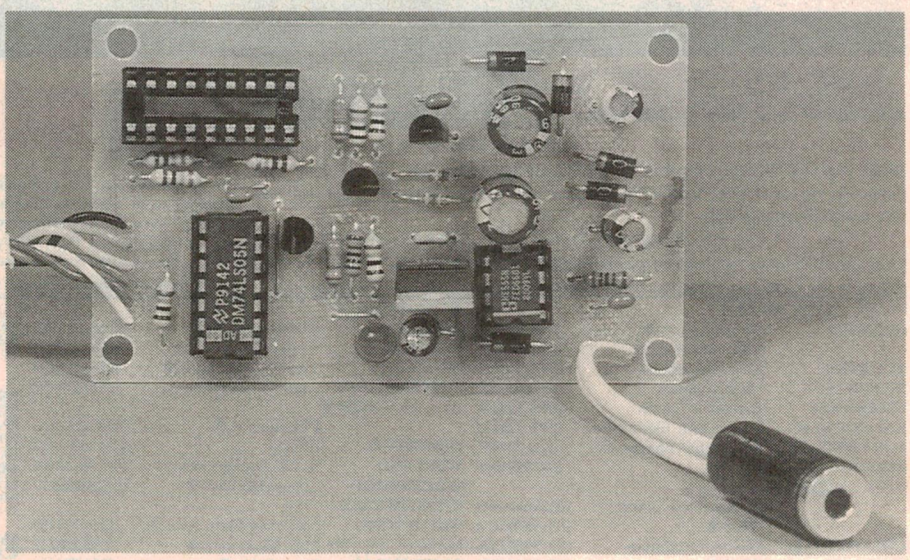
The programmer

It is possible to build a simpler programmer for the 16C84, however this could reduce its reliability. This programmer has been specially designed for the amateur and it was decided to include some extra circuitry to make it more reliable and easier to use. The circuit schematic is shown in Fig.1, while that for the matching cable to the PC printer port is shown in Fig.2.

The programmer requires an input power supply of 9 to 12V DC. Although the programmer only uses about 20mA while idle and 40mA while busy, a supply of at least 100mA is preferable.

Such power supplies are readily available and are often used to power electronic equipment. A 9V battery is also sufficient and could be used for a portable system.

A word of caution, though: many power supplies produce quite a bit more than their nominal voltage, so ensure that the voltage does not exceed 12V. With minor modifications, as detailed



One of the author's prototype boards for his PC driven programmer for the PIC16C84 microcontroller chip.

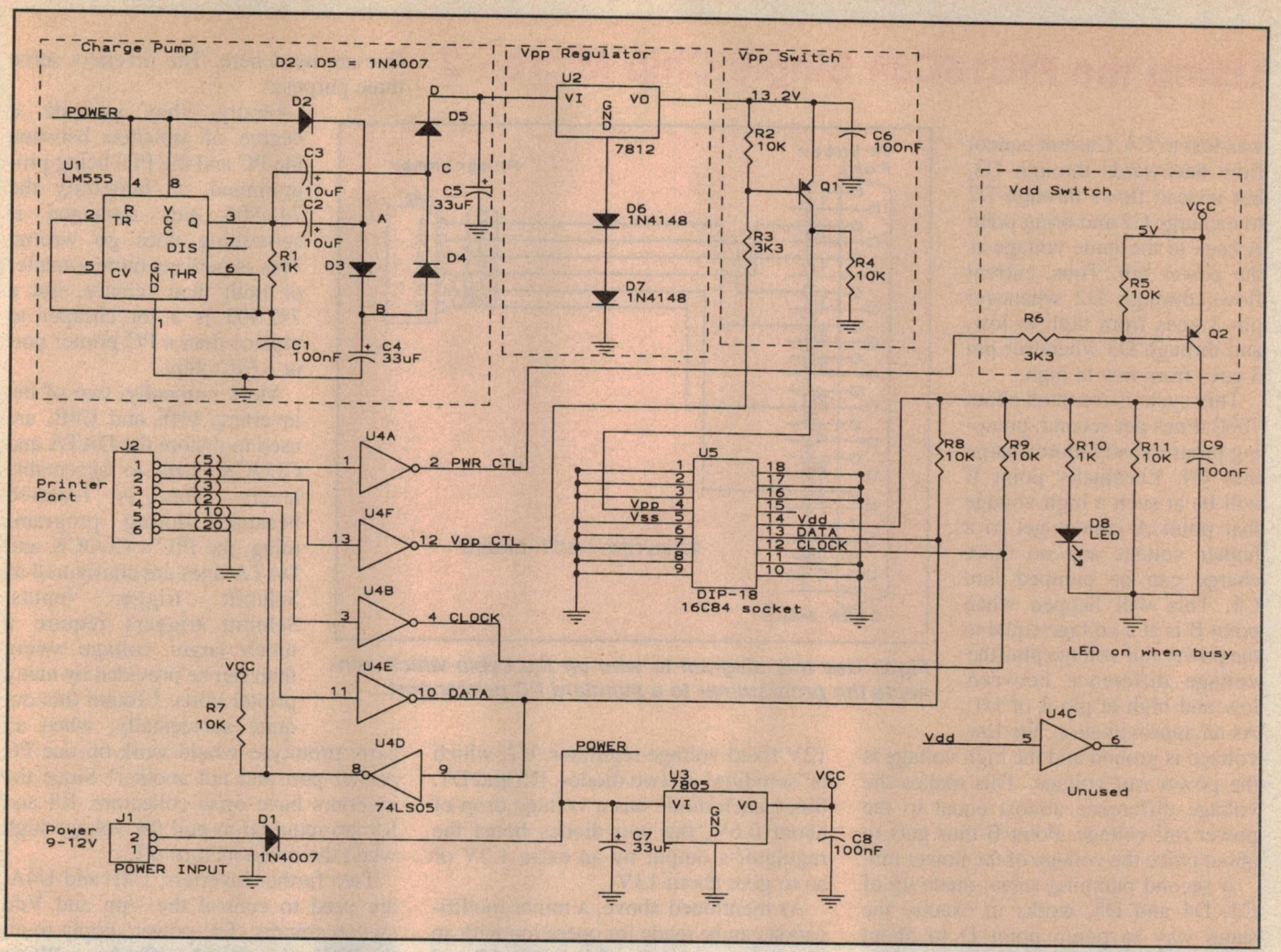


Fig.1: The schematic for the PC driven programmer. As you can see, it's very straightforward and uses a very small number of low cost components. U1 is used to generate the programming voltage.

later, the programmer will operate with an input voltage of up to 15V.

The power is fed into the programmer via a diode, D1, which prevents reversed polarity power from being fed into the circuit and perhaps causing damage to the programmer and the PC. Simple goof-proofing like this has saved many circuits. There is a voltage drop of about 0.6V across the diode.

The PIC requires two different voltage levels during programming, 5V for normal power on the Vdd pin and a programming voltage of 12 to 14V on the Vpp pin. The 5V level is easily produced from the input power by using a common 7805 type 5V fixed voltage regulator, U3.

The 13V level is more difficult to produce, since it is at a higher voltage than the input voltage. This is overcome by using a 'charge pump' voltage converter. The programmer could have been kept a bit simpler by using a higher input voltage of 18V or so. The disadvantage of this approach is that 18V power supplies are not commonly available. Besides, this way provides an excellent opportunity to learn about a simple way to boost power supply voltages.

Charge pump (or flying capacitor) voltage converters are a lot simpler for the amateur to construct than their main rivals, the switch-mode power supplies, because they do not use inductors. They do however have some disadvantages; they are typically limited to low power throughput and are less efficient than switch-mode power supplies. Since the programmer only requires about 5mA at 13V, the complexity of tracking down suitable cores and winding inductors is just not worth the effort here.

The operation of a charge pump voltage converter may seem a bit strange at first, especially since all the energy is transferred through capacitors. However, once the principles are understood it all makes a lot more sense.

Our trusty friend, the common old 555 timer IC, U1, is configured as a square wave oscillator. The frequency of the oscillator is set by R1 and C1 to give a frequency of f(Hz)=0.7/(R*C). A square wave of about 7kHz is thus produced at pin 3 of U1.

Consider now diodes D2 and D3, ignoring for now the voltage drop across them for the sake of simplicity. When the circuit is switched on, current will flow from the power rail through the diodes until the voltages at points A and B are the same voltage as the power rail.

Now if pin 3 of U1 was high and goes low, the voltage at point A will decrease. Current will flow through D2 to recharge C2, so that point A is restored to the power rail voltage. When pin 3 goes high the voltage at point A is pushed higher than the voltage of the power rail and point B. Current cannot flow backwards through diode D2, but it can flow through D3 — discharging C2 and charging C4 until points A and B are at the same voltage.

When pin 3 goes low again, point A will be at a lower voltage than the power rail because some of the charge in C2

Using the PIC16C84 Single Chip Micro - 2

was lost to C4. Current cannot flow backwards through D3, but instead flows through D2 to recharge C2 and bring point A back to the same voltage as the power rail. Thus, current flows through D2 whenever pin 3 goes from high to low, and through D3 whenever pin 3 goes from low to high.

This cycle is repeated about 7000 times per second, pumping progressively more charge into C4. Eventually point B will be at such a high voltage that point A cannot get to a higher voltage and no more charge can be pumped into C4. This will happen when point B is at a voltage equal to the power rail voltage plus the voltage difference between low and high at pin 3 of U1. As an approximation, the low voltage is ground and the high voltage is the power rail voltage. This makes the voltage difference almost equal to the power rail voltage. Point B thus gets to about twice the voltage of the power rail.

A second pumping stage, made up of C3, D4 and D5, works in exactly the same way to pump point D to about three times the power rail voltage.

If you are not entirely convinced at this point, consider the following mechanical analogy. Consider a foot pump; it has an input valve (D2), an output valve (D3) and a piston (C3). When the piston is pulled back by a force (U1 output goes low), air flows through the input valve. When the piston is forced forward (U1 output goes high) air is forced out of the output valve. The name 'charge pump' does make sense!

Of course we live on planet earth, so a bit of reality creeps in to mess up this perfect picture. The 0.6V drop across each of the diodes does reduce the efficiency of the charge pump, and point D thus never actually gets all the way to three times the power rail voltage. Power is drawn from the circuit constantly, thus reducing the voltage even more. However the output is still high enough to provide a reliable supply to the Vpp voltage regulator.

The output from the charge pump is reduced to the 12 to 14V range by using a 7812 type 12V fixed voltage regulator, U2, which is 'standing' on two diodes, D6 and D7. Since each diode has a voltage drop of about 0.6V, the two diodes boost the regulator's output by an extra 1.2V or so to give about 13V.

As mentioned above, a minor modification can be made for operation with an input power supply of between 12 and 15 volts. All that is required is to remove C3. This effectively disables the second pumping stage and prevents the charge pump output voltage from rising too high and destroying U2.

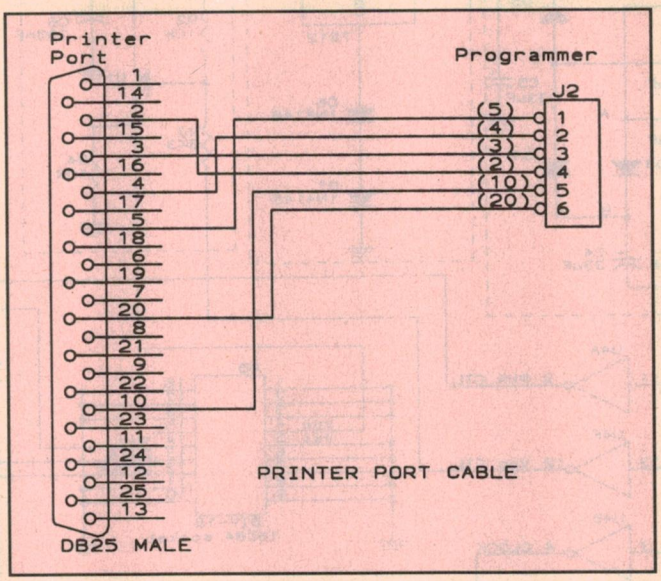


Fig.2: Use this diagram to wire up the cable which connects the programmer to a standard PC printer port.

Signal buffer

The signal lines between the PC and the programmer are passed through a 74LS05 open collector inverter, U4. This device has six inverters, of which five are used here. The inverters serve three purposes.

Firstly, they provide a degree of isolation between the PC and the PIC being programmed, so hopefully the 74LS05 gets damaged if something does go wrong. This is perhaps more a matter of faith than science, but a 74LS05 is a lot cheaper to replace than a PC printer port or a PIC chip!

More rationally, two of the inverters, U4E and U4B, are used to restore the DATA and CLOCK lines to acceptable levels. This is required because, during programming, the PIC's CLOCK and DATA lines are configured as Schmitt trigger inputs. Schmitt triggers require a much larger voltage swing than can be provided by many printer ports. I found this out quite accidentally, when an early prototype would work on one PC printer port and not another! Since the inverters have open collectors, R8 and R9 are required to pull the voltage high when the inverters turn off.

Two further inverters, U4F and U4A, are used to control the Vpp and Vdd switch circuits. The power supply to all the PIC's pins must be off when a PIC is being removed or plugged into the socket. The Vdd switch circuit is only turned on while the PIC is being accessed.

Since the inverters have open collector outputs, they do not sink or source current while the output is high. When the output of U4F goes low it sinks current, causing PNP transistor Q2 to turn on and supply power to the PIC's Vdd pin. This power is also used as a pull-up voltage for R8 and R9. Current flowing via R10 lights the LED, D8, to indicate that the programmer is busy. When the Vdd switch is turned off, the charge in C9 is quickly drained via the LED and via R11 so that it is safe to remove the PIC from the circuit.

A similar circuit is used for switching on the programming voltage Vpp, using transistor Q1.

Although using a totem-pole (or active pull-up) driver could have done away with the pull-up resistors, an open collector driver was selected for this job for a few reasons. Firstly, the PIC DATA pin is used for both

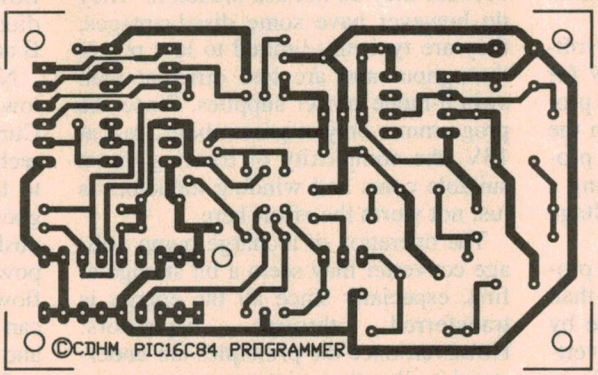


Fig.3: The PCB pattern for the programmer board, reproduced here actual size as usual, for those who want to 'roll their own'.

input and output; if a totem-pole type driver was used, there would be no way to turn off the driver and it would 'fight' with the PIC's DATA pin when it is in output mode. An open collector driver does not have this problem; when its output is high, the driver does not source current and thus does not affect the output of data from the PIC.

Secondly, open collector drivers can be used much like a transistor in the grounded emitter configuration; this property is used to sink base current for the two switching transistors, Q1 and Q2. A totem-pole driver would be able to cope with controlling the Vdd switch, but not the Vpp switch because the Vpp base voltage is much higher than a totem-pole device could handle. As a result Q1 would never turn off...

An inverting driver was selected for U4 because the PC printer port outputs are low when the PC is started up. If a non-inverting buffer was used then the Vpp and Vdd switches would be on by default. This was considered undesirable. The inverting driver turns Vpp and Vdd off by default.

The output of the data output buffer, U4D, is pulled up by R7 to provide robust signal levels to the printer port.

Construction

This programmer can easily be built on either Veroboard or a PCB made from the etching pattern provided. The pattern for a suitable small PCB is shown in Fig.3, actual size, while the matching wiring overlay diagram is shown in Fig.4.

Construction is quite straightforward. Care should be taken to ensure that the components are soldered in correctly. Many of the components are polarity sensitive and must be inserted with the correct orientation.

If you are using the PCB, ensure that you solder in the two wire jumpers near D8 and U4. It is wise to use sockets for U1 and U4 so that they can be replaced in the unlikely event of a failure. This also makes testing easier.

Note that although 7805 and 7812 (i.e., TO-220) voltage regulators have been specified, the circuit will function just as well with the smaller 78L05 and 78L12 regulators.

Virtually any six-conductor cable is suitable for the cable between the PC and the programmer. The cable should be long enough to get from the back of the PC onto the workbench, though no longer than is necessary.

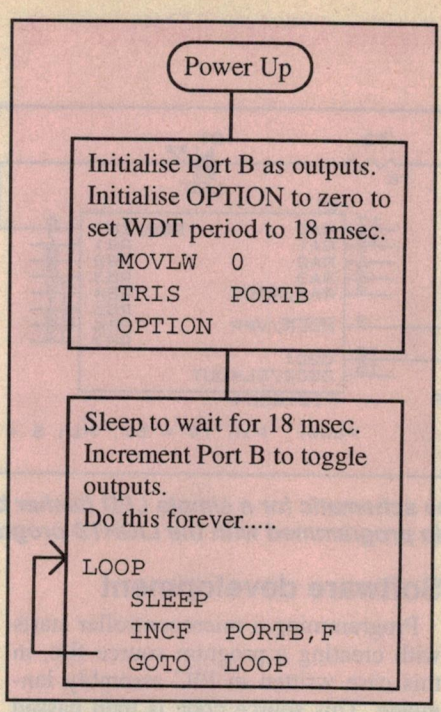


Fig.5: A flow chart for the author's LIGHTS program, used as a simple example of PIC chip programming.

The cable on the prototype is about 1.5m long. The PC end is terminated with a 25-way male D type connector. This should be a solder lug type and the conductors are soldered directly into the relevant solder lugs. The back of the connector should be protected with a purpose made cover or 'back sheel'. This protects the back of the plug against short circuits and the strain relief prevents conductors from damage.

If you have recently won the lottery, you might want to splash out and buy a zero insertion force (ZIF) socket for U5. These are normally used in professional programmers, because they are a bit easier to use. They are however quite expensive, and often difficult to find. A common old IC socket will be fine, so long as you are reasonably careful when inserting and removing the PIC during programming.

The cheap dual-wipe type sockets seem better for this job than the fancy machined pin type, because they seem stand up better to repeated insertions. It is an easy matter to carefully push the PIC into the socket and extract it with a lever such as a flat blade screwdriver.

A word of caution, though: it is easy to get careless and bend an IC pin. Do this a few times and you will break off a pin — which renders an otherwise perfect IC completely useless, causing wailing and grinding of teeth!

A good way to protect against this to keep the IC permanently plugged into an IC socket piggy-back style. The PIC and its protective socket are treated as a unit and handled together.

If a pin gets damaged, then only the IC socket needs to be replaced — a much cheaper exercise. Machined pin IC sockets are the best for this job; the pins are a lot stronger than those of dual wipe IC sockets and stand up well to general abuse.

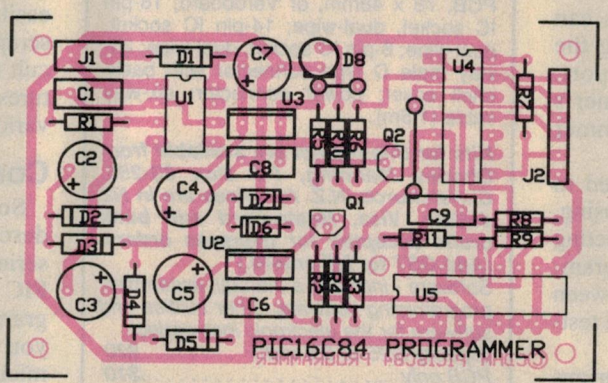


Fig.4: The overlay diagram for the programmer board, showing where everything goes and their correct orientation. Note the two small links, one near D8 and the other between Q2 and U4.

Programmer testing

The programmer is very easy to test and no calibration is required. Firstly inspect the finished PCB for any bad solder joints and short circuits. You might also consider a last check for missing or wrongly inserted components.

Next, remove U1 and U4 from their sockets and unplug the programmer from the printer port. Then turn on the power, and check that the power entering the programmer is the correct polarity and in the range 9 - 12V. The output from U3, measured across C8, should be 5V. The voltage measured between pins 7 and 14 of U4 should also be 5V. If this is correct, then U3 and its associated circuitry are working correctly.

The LED should not be lit. The voltage between pins 5 and 14 of the PIC socket should be zero (well at most, a few millivolts). Now place a jumper wire between pins 7 and 2 of U4's socket.

This should cause the LED to light up, and the voltage between pins 5 and 14 of the PIC socket

Using the PIC16C84 Single Chip Micro - 2

should now be 5V. Removing the jumper should extinguish the LED and cause the voltage to return to zero. This has tested the Vdd switching, LED and associated components.

Now remove the power and plug U1 into its socket. Turn on the power and check the voltages in the charge pump. Point B, measured across C4, should be at almost twice the power rail voltage (as measured between pins 1 and 8 on U1). Point D, measured across C5, should be at almost three times the power rail voltage and at least 18 volts. If any of these voltages is incorrect, then recheck the charge pump circuit, the polarity of diodes D2 - 5 and capacitors C2 - 5 in particular.

The output of U2, measured across C6, should be about 13.2V. The Vpp switch should be off, so the Vpp voltage, measured between pins 5 and 4 on the PIC socket, should be zero.

Now place a jumper wire between pins 7 and 12 of U4's socket. This should turn the Vpp switch on. The Vpp voltage, between pins 5 and 4 on the PIC socket, should now be about 13.2V. The current drain should cause the voltage of the charge pump output, measured across C5, to drop slightly, but it should remain above 16V.

Removing the jumper should cause the Vpp voltage on the PIC socket to drop back to zero. This has tested the Vpp regulator and Vpp switch circuits. Remove power. U4 should now be plugged into its socket.

Once the software has been installed on the PC, further tests can be run. Turn off the PC and plug the programmer into the printer port. Turn on the PC and the programmer's power source. Start the programmer software by typing PP84.

Before proceeding, you will need to select which printer port you are using. This is done by entering S and selecting the desired printer port. The programmer itself, and the connection between the PC and the programmer, can be tested by entering T.

Once in the test mode, the various voltage levels can be set and tested on the various pins.

Now the programmer should be fully functional, and it's time to try out a simple development cycle.

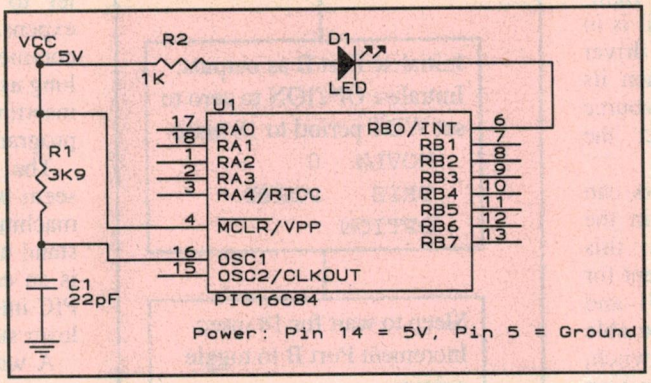


Fig.6: The schematic for a simple LED flasher based on a PIC chip programmed with the LIGHTS program.

Software development

Programming a microcontroller starts with creating a program source file, in this case written in PIC assembly language. This source code is then passed through a translator program known as an *assembler*. The assembler converts the human readable form of the program into the actual binary code which can be downloaded into the PIC.

If the assembler cannot understand part of the assembly language source file, then it displays the errors. The source file must then be edited to correct these errors and the program should be passed through the assembler again.

Once the code has been successfully assembled, it can be programmed into the PIC. This is done by the programmer control program, PP84. The PIC is then plugged into the circuit and tried out. If something goes wrong, the error has to be tracked down in the source code and the whole cycle is repeated. This is often referred to as 'crash and burn' development.

Traditionally, the first program that any 'C' language programmer tries is called the 'hello world' program. This is almost a peace offering to the gods of 'C', and to skip this important step is to invite a cursed programming career. Similarly, microcontroller developers religiously type in LIGHTS as a first program for any new development.

LIGHTS is just a very simple program which flashes an LED. This isn't really as crazy as it seems; getting LIGHTS to work proves that a lot of the circuit works. The code for LIGHTS is included on the software distribution disk.

Fig.5 shows a flowchart for the LIGHTS program, while Fig.6 shows the schematic for the simple LED flasher based on a PIC 16C84 chip programmed with this program. As you can see it's about as simple as it gets and can easily be built on a breadboard or a scrap of veroboard. This is a useful circuit for experimenting with various features, such as watchdog timers and the various oscillator modes.

PARTS LIST

Semiconductors

U1 LM555 timer IC
U2 7812 or 78L12 voltage regulator
U3 7805 or 78L05 voltage regulator
U4 74LS05 hex inverter (o/c outputs)
Q1,Q2 PNP transistor such as BC327
D1-5 1N4007
D6-7 1N4148
D8 LED 3mm or 5mm

Resistors

All 0.25 watt:
R1,10 1k
R2,4,5,7,8,9,11 10k
R3,6 3.3k

Capacitors

C1,6,8,9 0.1uf monolithic ceramic
C2,3 10uF 50VW radial electrolytic
C4,5,7 33uF 50VW radial electrolytic

Miscellaneous

PCB, 78 x 48mm, or Veroboard; 18-pin IC socket, dual-wipe; 14-pin IC socket, dual wipe; 8-pin IC socket, dual wipe; 25-way male D type connector with backshell cover; power connector; six-way cable (1.5m).

Kits for this project are available from Charles Manning, PO Box 33-256, Christchurch, N.Z. All prices are in NZ dollars. Visa, MasterCard and bank drafts accepted for overseas orders. (Add GST for NZ orders.)

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Conclusion

So far in this series we have described the PIC microcontroller series, with particular emphasis on the PIC 16C84, and built a simple programmer for it. This is everything that you need to start developing your own microcontroller based projects.

In the third and final article in this series, we'll present a sample project which uses many of the 16C84's special features, to implement an electronic lock. ❖

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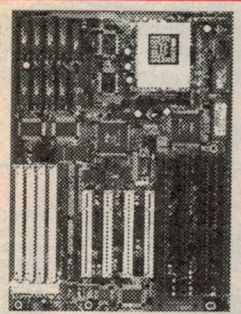

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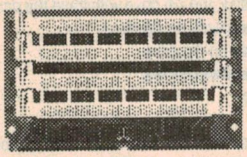

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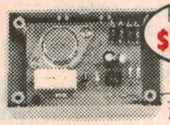

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Kit review:

WORLD'S SIMPLEST ELECTRIC MOTOR!

An electric motor made up of only five parts? It can be done, and this small and low cost kit from Dick Smith Electronics shows you how. Needing only a standard 'D' cell to get you going, it provides an easy way to learn the basic principles of electric motor operation.

by GRAHAM CATTLEY

Electric motors are perhaps one of the most common means of converting electrical energy into mechanical energy that you will find today. Used in electrical-mechanical equipment ranging in size from the massive engines used to propel submarines, down to the tiny motors used in watch movements, all electric motors take advantage of the one electrical phenomena — discovered by Hans Christian Oersted (1777-1851). He was the first to record that a wire carrying an electric current generates a magnetic field.

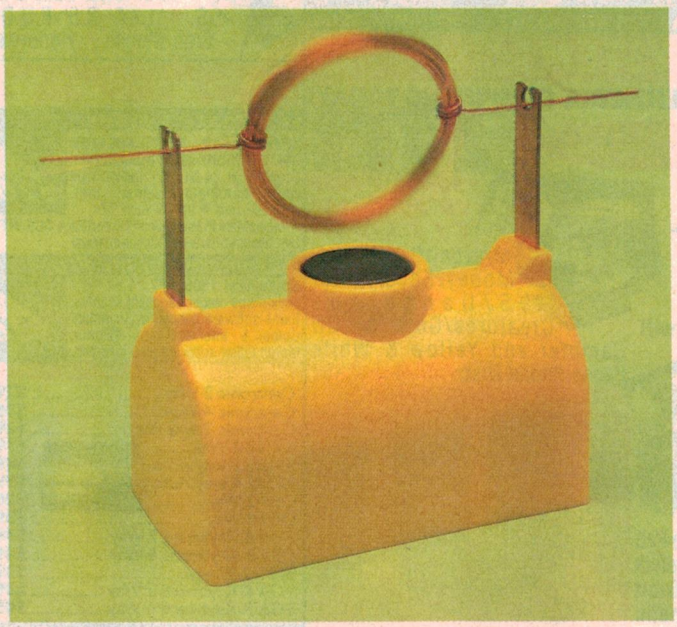
It was later found that, by winding the wire into a coil, a much stronger magnetic field was generated. This then opened the way to practical electric motor designs, which have remained largely unchanged to this day.

The operation of electric motors is based on the fundamental principle that opposite magnetic forces attract, while like forces repel — it's these magnetic forces that cause the motor to rotate.

Many electric motors that are designed to run on DC consist of a fixed permanent magnet, surrounding a central rotating electromagnet called an *armature*. When current is passed through one of several coils arranged around the armature, the magnetic field generated swings the armature around to align with the poles of the permanent magnet surrounding it.

As the armature turns, electrical contact to the coil is broken and the next coil is energised, whereupon *it* is attracted to the poles, causing the rotation to continue as long as power is applied.

The fairly complex switching system required to energise each coil in turn is achieved by the use of a *commutator*. A commutator usually consists of a series of contact strips arranged in a cylinder, so that a pair of fixed wire or conductive carbon brushes can make contact with each of the coils (generally one at a time) as they pass. To make motors more powerful, several sets of coils may be used at once, some being attracted in one direction, while the rest are being repelled in the other.



Simple motor

As you can imagine, the Simplest Motor In The World is not nearly so complicated. To start with, it has the simplest possible armature: a single coil of wire, suspended on very simple bearings which also act as brushes for the most basic form of commutator possible, to allow the coil to be energised only once per revolution.

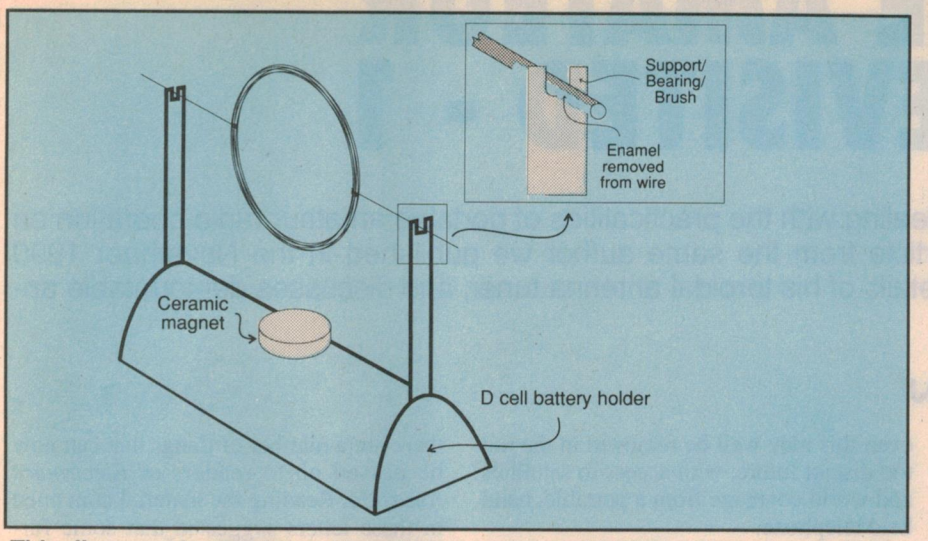
A permanent magnet is positioned directly underneath the coil assembly, and the coil is carefully balanced so that as it starts to rotate, the bearing/brushes make electrical contact with the coil-lead 'commutator', causing the coil to become an electromagnet. When this happens, the coil is repelled by the permanent magnet, giving it enough of a kick to spin one whole revolution, whereupon the whole process repeats.

This results in the coil rotating on its axis at quite a respectable speed. And while it may not be the most powerful motor in the world, it certainly lives up to its name as the simplest demonstration of such an involved concept that we have seen.

The kit comes in a small bubble pack package, and on opening it we found a D size battery holder, a 15mm ceramic disk magnet, two battery clip/supports/bearings/brushes and a small hank of 22 gauge enamelled copper wire. The instructions on the back of the package did a reasonably good job of explaining the construction procedure, which amounted to inserting the two battery clips and magnet into the holder and winding the coil.

The coil consists of 10 turns of wire which are wound using the battery as a former, with the wire's ends wound around each side of the finished coil to stop it from springing apart. These ends then protrude radially from the sides of the coil, and are trimmed to about 20mm long so that they can act as both a support for the coil and as its 'simplest possible' commutator.

Now, the whole point of a commutator



This diagram clearly shows the relative position of both the 'armature' and the magnet. Note how the insulating varnish is removed from one side of the armature's support wires, allowing current to flow through the coil only during one half of its rotation.

in a motor is to supply current to the coil only when it is in the correct position. This is achieved by carefully removing (scraping off) the enamel from one *side* of the two support wires, on each end of the coil. In this way, the exposed side of the wire makes contact with the 'bearing/brush' only as the correct side of the coil approaches the magnet.

Current then flows through the coil and the magnetic field generated pushes the coil away from the magnet, making the motor spin.

The coil windings will need to be carefully adjusted so that the coil spins freely on the supports without too much wobble. You will probably have to slide the windings around a bit in order to get it to balance, but as the speed of the motor is dramatically improved when balanced correctly, it is well worth going to the extra effort.

Having installed a D-sized cell into the holder, carefully place the coil on the two supports and let it go; it should start flipping over and over building up speed. (If it doesn't take off straight away, you may have to give it a bit of a poke to get it started...) With a well balanced coil and a fresh D cell, you can expect a top speed of around 300rpm.

Experiments

The back of the package gave a short list of simple experiments to try — including the connection of a small 1.5V light bulb across the two supports, which will flash as the coil spins, and holding the magnet above the coil instead of beneath it.

A couple of other ideas that sprang to mind while we were playing around with it were to reverse either the battery, the coil or the magnet (any one of which would reverse the motor's direction); holding another magnet above the coil; and to hold the coil stationary above the magnet so that you can feel the magnetic force used to drive the motor.

While this last experiment certainly demonstrates the fact that a high current through the coil will produce a strong magnetic field, it also demonstrates another basic electrical fact: P=IR. Yes, the coil gets hot!

This is quite understandable as the current through the coil can rise to a couple of amps, particularly with an alkaline battery.

It also occurred to us while we were trying out the motor, that if you were really adventurous you could try winding a fancier 'armature', with two or more coils and their connections all brought out to the ends and scraped carefully, to make a more elaborate 'commutator'. There's certainly lots of room for experimenting and learning...

Of course it was only a matter of minutes before one of us had also knocked up a home-made version, using a couple of paperclips soldered directly onto a battery. While it wasn't terribly pretty, it did demonstrate that this type of motor is surprisingly easy to get going and that anyone with an interest in electricity would have no trouble in putting the kit together. As a motor kit that will almost certainly work first time round, you probably can't go past it.

The World's Simplest Motor is available from all Dick Smith Electronics stores (catalog number K-1046) at a RRP of $8.50. ❖

PORTABLE AMATEUR RADIO REVISITED - 1

Here is the first of three articles dealing with the practicalities of portable amateur radio operation on HF, and following on from an article from the same author we published in the November 1990 issue. This article gives further details of his toroidal antenna tuner, and discusses demountable antenna options.

by PETER R. JENSEN, VK2AQJ

At the present time, when all that is required to have access to a cellular telephone is the cash to purchase it, the advantages of an amateur radio licence would appear to be somewhat under challenge. Certainly this would seem to be true of the amateur operating on two metres with a portable rig.

These days, when a radio amateur puts a two-metre rig close to his lips, the casual observer might be forgiven for assuming that here was yet another techno-yuppie simply showing off the latest toy. For the enthusiastic radio amateur, this looks to be a situation which is unlikely to change in the future and may have a profound impact on the recruitment of people to amateur radio. That is unless amateur radio can offer something that, as compared with the modern mobile telephone, is unusual and interesting.

At the present time, it is in portable *long distance* communication that the radio amateur still retains a significant advantage over the user of the modern commercial telephone system. However even this may well be removed in the not too distant future, with access to satellites and world coverage from a portable, hand held telephone.

In the meanwhile, and given the possibilities of access to world communication with a modest sized transceiver, further consideration has been given to the subject of portable operations for the radio amateur. In particular the concern has been to determine the best means of obtaining good results from this interesting, if sometimes frustrating, activity, on the basis of limited resources.

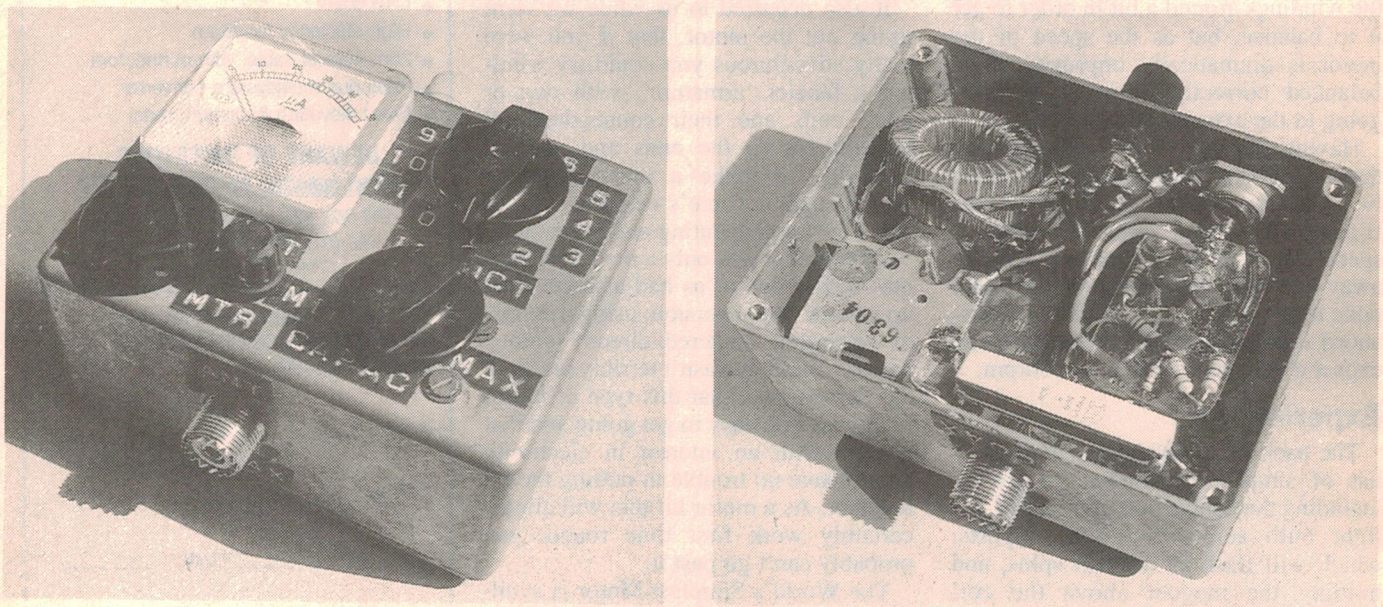
Portable operation

As may be recalled, some time ago an article of mine ('Amateur Radio out of a Suitcase') was presented in this magazine, dealing with a number of practical problems of operating a portable amateur station. Following this article, a number of letters of enquiry were received relating to certain aspects of the material presented.

In part prompted by these enquiries, there are a number of things that can now be passed on to readers of *Electronics Australia*. Reading the material contained in these letters suggested that some further information was required, in particular relating to the antenna tuner. This had been rather briefly referred to, in conjunction with the description of the bridge tuning unit, which had been a specific subject of the earlier article.

One small advantage that the delay in responding has produced is that it has allowed not only the question of the tuner to be considered again but also certain other matters to be reviewed. Amongst other things, the problem of finding an effective and lightweight portable power supply has received a good deal more consideration. This has resulted in the development of a means of employing a switch mode power unit, as used to run computers, to provide electrical energy to the transceiver.

A successful unit has been developed based on a commercial supply. This is in spite of the terrible racket of electro-



External and internal views of the author's very compact antenna and matching unit, based on a ferrite toroid.

magnetic 'hash' that these devices tend to produce in a sensitive shortwave receiver, unless some method of filtering is used.

The toroidal tuner

First of all, it is appropriate to present the additional information concerning the toroidal antenna matching unit, with its switching and tuning system. In reality a good deal of the data that is required can be deduced from the photograph of the device.

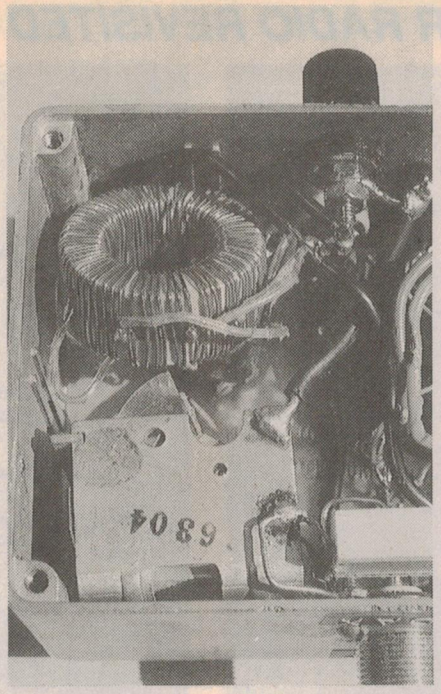
The principal component is a high frequency range ferrite toroid, with a diameter of approximately 50mm. This was originally purchased many years ago from the electronics firm Martin de Launay, which was at that time Australian agent for the American Company Amidon.

Reference to my personal filing system reveals that the original version of the toroidal tuner was based on a design presented in the *ARRL Handbook*, published by the American Radio Relay League sometime during the 1970's, and employed an Amidon toroid, type T-130.

For a contemporary source of suitable toroids, one will have to scout around but contact with Jaycar Electronics reveals that they stock a toroid made by Neosid, type 1-146-10. This component is 44mm in external diameter and 24mm internal diameter, and should fit the bill quite adequately.

All that you will now require is a sufficient amount of 22 gauge enameled copper wire, together with a multi-pole rotary switch. The device illustrated in the article features a single pole rotary switch with 11 positions and is usually available from the major suppliers. The 70 turns of wire around the toroid have 11 evenly spaced tappings and are as indicated in the additional sketch.

This is nearly double the original number of turns specified in the *ARRL Handbook*, but the tuner was built to be used on 80 metres and with relatively short wire or whip antenna. The Dick Smith transceiver was, of course, designed for Novice use on the 80 metre band.



A close up view of the tapped toroid inside the antenna matching unit.

As was apparent in the earlier article in *EA*, the tuner employs a simple 'L' network consisting of the toroidal inductor and a double-gang tuning capacitor of some 400pF total capacity. These ganged capacitors are still available from the firm of L.E. Chapman, which is located on the Warringah Peninsula at Dee Why.

Connections to the antenna, earth and the bridge tuning indicator have also been shown for clarity. They should be read in conjunction with the previous article. However the tuner will work quite satisfactorily with a standard SWR meter, rather than the bridge tuning unit previously described.

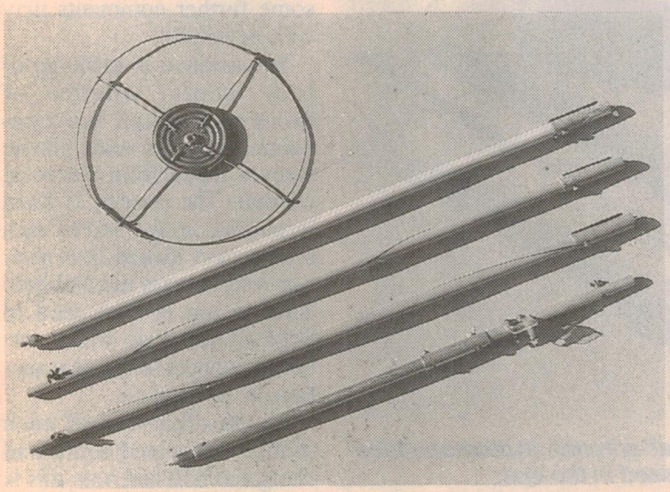
More portable antenna

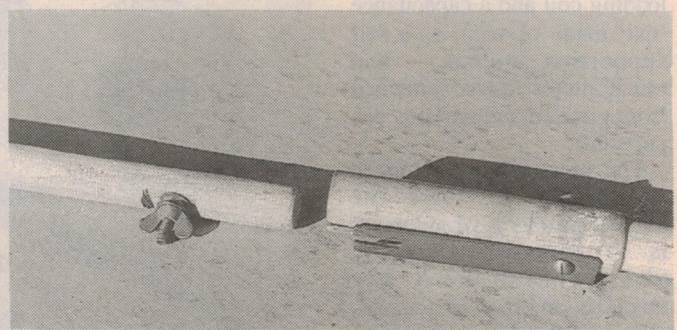
As earlier discussed, the erection of a suitable antenna in the confines of the average motel is one of the most intractable problems that the traveller must face. While there is no real substitute for a couple of nice high trees and a dipole strung between them, usually the best that can be achieved is a reasonably vertical wire antenna, slung up into whatever shrubbery may be available. The earth system remains something of a problem, as previously discussed.

While it should not be necessary to introduce many amateurs to the useful and flexible G5RV dipole, it is perhaps worth including the basic design information. This has been shown in the accompanying diagrams and it should be noted that with the dimensions as shown, the antenna works best and with minimum SWR on the 20 metre band.

If it is to be used on other amateur bands, and at significantly greater power levels than are produced by the Dick Smith transceiver (30W PEP), it is preferable to make use of an antenna tuning unit of the kind to be described later. Indeed with a modern solid state transceiver, use of a tuning unit is effectively mandatory. This sort of transceiver is usually quite intolerant of high SWR, and is generally designed to progressively shut down the power output to the antenna as the mismatch increases.

Sometimes, despite careful reconnoitering, the layout of the motel accommodation will be such as to prevent access to any form of outdoor support to which one can attach a wire antenna. When this is the case, one has little option but to use a self- supporting form of vertical antenna. It is no surprise that the military tend to make exclusive use of whip antennae for portable and vehicle mobile operations. It's rather impracticable to carry around a demountable tree, of course!

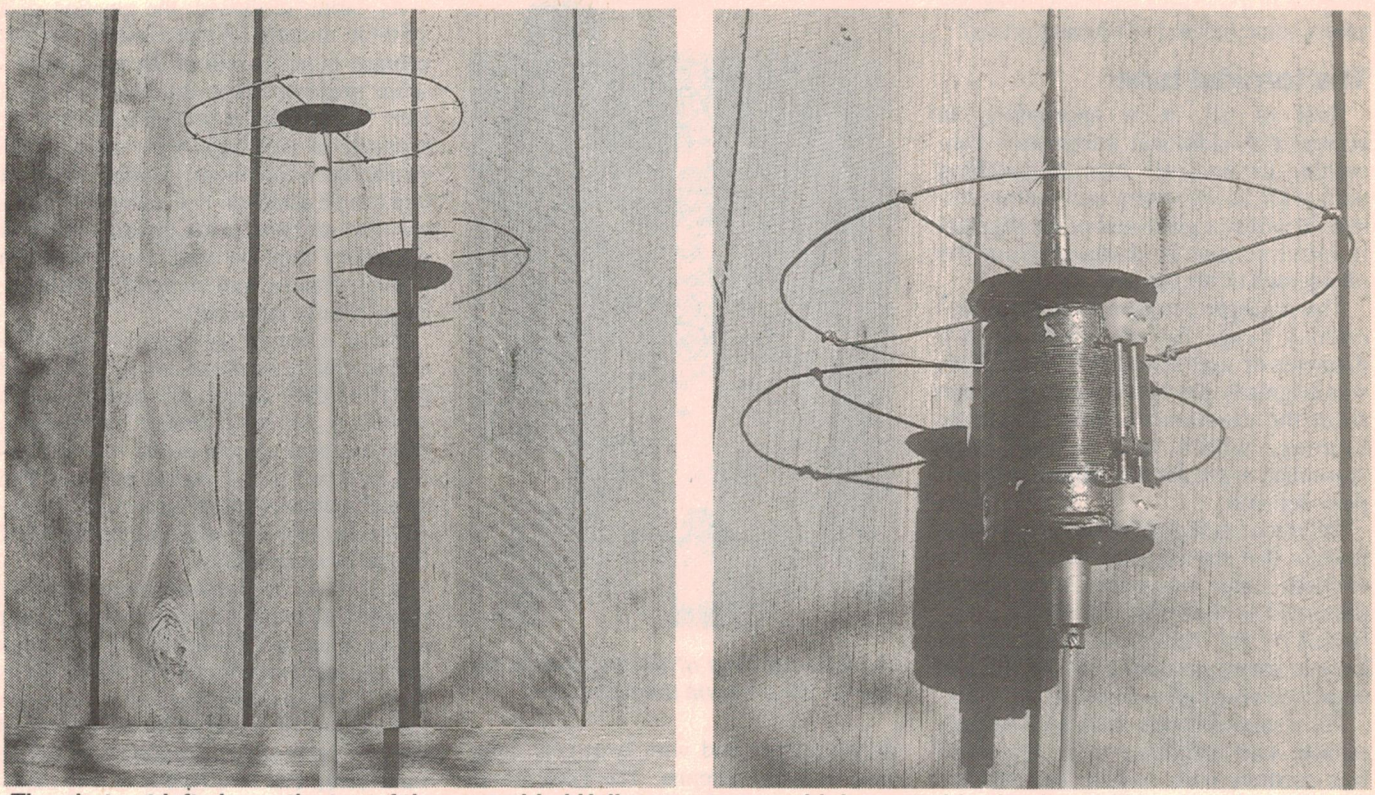




Above: The connector system used to join the sections of the 'Heli-vert' demountable antenna.

Left: The complete Heli-vert antenna in disassembled form. The unusual circular object at upper left is the author's capacitive 'hat' made from coat hanger wire and a tin lid.

PORTABLE AMATEUR RADIO REVISITED - 1



The photo at left shows the top of the assembled Heli-vert antenna, with its capacitive hat in position. At right is the top loading section of the 'Lifeboat' antenna, showing the adjustable loading coil, capacitive hat and top whip.

There is however a practical limit to the length and weight of a vertical self-supporting antenna. The length for a traveller is usually set by the size of the suitcase that is carried and the weight by what can be accommodated on the airport scales. This is quite apart from the problem of convincing airport staff that anyone who carries long metal rods in his luggage is not some sort of mad assassin with a well concealed weapon!

Despite these irritating problems, the author has carried from time to time aluminium rods, a loading coil and a capacitance 'hat' made of wire, as a self supporting antenna — and much interest it has generated from puzzled and nervous airport staff.

The most recent attempt at an antenna to solve the logistic problems of air travel is fortunately largely transparent to the X-Ray machine, and therefore causes a lot less consternation. However, if one is ever asked to open one's bags, it looks pretty weird and will take a certain amount of explaining.

Despite this it certainly works, and if you are desperate for a suitable tree and the only other option is 'chances', this antenna may be just the thing that you have been looking for.

As every engineer and architect knows, wood is without doubt one of the most structurally efficient materials that can be used where weight is a major consideration.

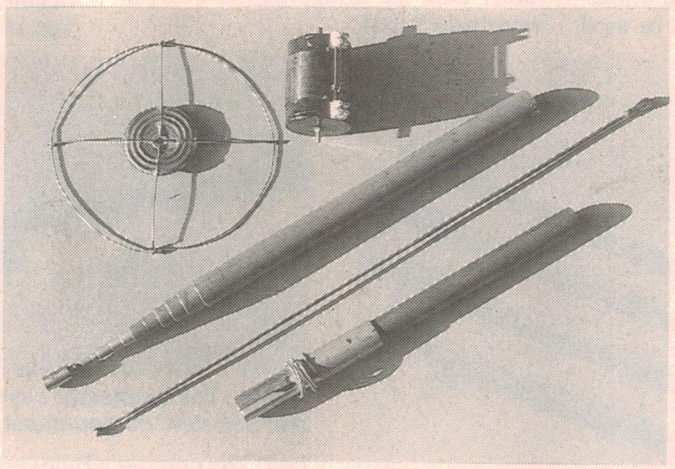
In certain forms, for example bamboo, its structural strength as compared with its weight simply puts steel to shame. This is the reason that so many radio amateurs, over the years, have turned to bamboo when they were looking for an elegant solution to the problem of supporting the wires of a Quad antenna.

In the antenna to be described, not bamboo but common dowelling, as available from the local hardware store, was used. While not as strong as bamboo perhaps, it is more than adequate for the task and in many ways a lot easier to use than aluminium or other metal tubing.

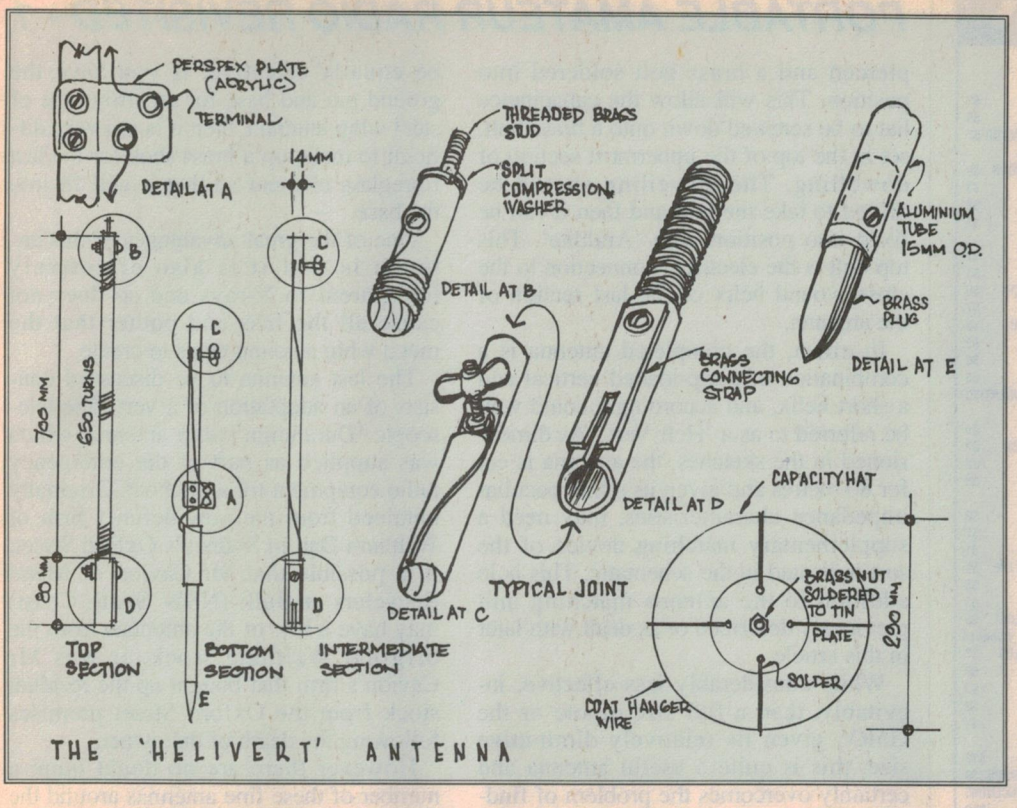
The best description of the form of construction is probably given in the illustrations and dimensioned sketches. However some further comments may well be helpful.

The antenna is made up of four short lengths of doweling which are connected together with plastic sleeves made from electrical conduit. The conduit is fixed in position at one end of each section and locked into position with a brass nut and bolt. This fixing is also used to hold a brass strap which serves to connect to the next section of the antenna.

At the other end of each section is located a nut and elongated bolt and onto this is



The author's telescopic 'Lifeboat' antenna, in disassembled form. Its construction is discussed in the text.



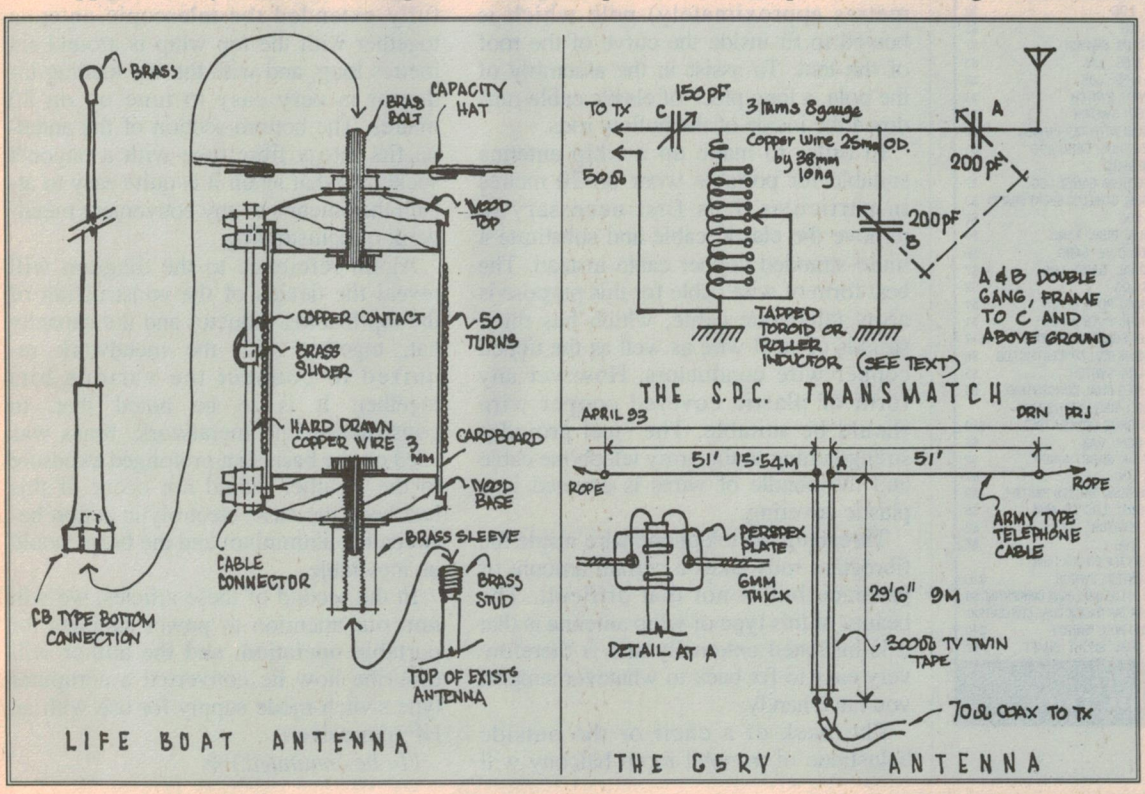
Use this detailed drawing by the author as a guide if you wish to make a copy of his Heli-vert antenna.

put a brass wing nut. This bolt also serves as the fixing point to the antenna wire. On the two lower sections the antenna wire is simply a slow helix of about three turns, running between the top and bottom bolt.

The topmost section, which does all the work, consists of a close wound length of wire approximately a half wavelength long or around 40.5 metres. Plastic covered multi-stranded copper wire is available from the usual suppliers and this is eminently suitable.

Above the top section is located a capacitance hat made from coat-hanger wire. This should be new and shiny so that when the metal bending and fabrication is complete, it will be possible to solder up all the joints with a hot soldering iron.

At the centre of the capacitance hat is a disk of tinplate and this can be most conveniently taken from a dog-food can or similar. Needless to say the disk should be cleaned before use, and it may be necessary to have a serious chat with the dog! The centre of the tinplate disk is



The left hand side of this three part diagram shows construction details of the adjustable loading coil and capacitive hat used by author in his Lifeboat antenna.

At upper right is the schematic of the SPC Trans- match, while at lower right are the basic details for the well known G5RV antenna.

PORTABLE AMATEUR RADIO REVISITED - 1

pierced and a brass bolt soldered into position. This will allow the capacitance hat to be screwed down onto a brass bolt, set in the top of the uppermost section of dowelling. The dowelling should be drilled to take the bolt and then it can be fixed into position with 'Araldite'. This top bolt is the electrical connection to the close wound helix of the last section of the antenna.

In effect, the completed antenna is a combination of a top-loaded vertical and a short helix, and accordingly could well be referred to as a 'Heli-Vert'. As dimensioned in the sketches, the antenna is cut for 80 metres and given its rather peculiar impedance characteristics, may need a supplementary matching device of the sort indicated in the schematic. This is in addition to the antenna matching unit previously described or as dealt with later in this article.

While considerably less effective, inevitably, than a full size dipole or the G5RV, given its relatively diminutive size, this is quite a useful antenna and certainly overcomes the problem of finding a 'sky hook' for attaching the wire antenna to.

Another type of antenna of the whip variety can be made up from fibreglass rods, which are now used to form the ridge pole of one of those newer type balloon tents.

The rods have a metal sleeve at one end and fit together to form a long (five metres approximately) pole which is bowed to fit inside the curve of the roof of the tent. To assist in the assembly of the pole, a long piece of elastic cable runs down the inside of the hollow rods.

In order to make up a whip antenna suitable for portable work on 20 metres in particular, it is first necessary to remove the elastic cable and substitute a multi-stranded copper cable instead. The best form of wire cable for this purpose is army telephone cable, which has three strands of steel wire as well as the tinned copper wire conductors. However any form of plastic covered copper wire should be suitable. The steel provides strengthening to the army telephone cable and the bundle of wires is covered in a plastic covering.

Threading the telephone wire inside the fibreglass rods takes a certain amount of patience but is not that difficult. The beauty of this type of whip antenna is that it is insulated externally and is therefore very easy to fix back to whatever support you have handy.

The back of a chair or the outside balustrade of a motel room balcony will be equally effective. If you have the ground pin and base for an army type of steel whip antenna, then it is not very difficult to make up a brass shoe for the last fibreglass element so that it will fit into the base.

One of the great advantages of this antenna is that it is also effectively transparent to X-rays and so does not cause all the fuss and bother that the metal whip antenna tends to create.

The last antenna to be discussed consists of an adaptation of a very fine telescopic 'Duralumin' whip antenna, which was supplied as part of the emergency radio equipment for a life boat. Originally obtained from the now defunct firm of Waltham Dan in Sydney's Oxford Street, it is possible that Mr Cavion of Metal Recyclers at Bulli (NSW South Coast) may have a few of the antennas from the original Waltham stock. It was Mr Cavion's firm that bought up the residual stock from the Oxford Street premises following the death of the owner.

However there are no doubt quite a number of these fine antennas around the amateur community, so it is worthwhile keeping one's eyes open.

The adaptation of the basic antenna consists of a new threaded top cap to the uppermost element, to which is screwed an adjustable inductor. Above the inductor is located a capacity hat and above that again is located a screw-on whip antenna about 1m in length. When fully extended the telescopic antenna together with the top whip is around six metres long, and with the top loading inductor is very easy to tune up on 80 metres. The bottom section of the antenna fits into a fibre tube with a bayonet socket, so that again it is quite easy to attach the antenna to any convenient metalwork or balustrading.

Again reference to the diagram will reveal the details of the construction of the top loading inductor and the capacity hat, together with the metalwork required to connect the various bits together. It is to be noted that, in constructing the metalwork, brass was used on the basis that prolonged exposure to the weather would not occur. If this had been the case, electrolytic action between the aluminium and the brass would be inevitable.

In the second of these articles, we will turn our attention to power supplies for portable operation, and the author will describe how he converted a computer type switch-mode supply for use with an HF transceiver.

(To be continued.) ❖

SHORTWAVE LISTENING

with **Arthur Cushen, MBE**

Unusual role played by Radio Japan

Radio Japan, which recently celebrated 60 years of operation, has had a checkered role, firstly as a pioneer broadcaster, then as a propaganda voice for the Government during WW2. Since then, it has become the major broadcaster from Asia, using relay points in all continents to achieve worldwide reception.

Broadcasting in Japan started on June 1, 1935, when shortwave transmissions came into operation under the slogan of Radio Tokyo. For more than ten years this continued, and included war time broadcasts.

During the war, Radio Tokyo was not only operating from Japan, but was also using transmitter in Shanghai, Manila Batavia, Singapore and many other sites which were under Japanese control as the Forces of Japan moved south into the Pacific area. The broadcasts from Radio Tokyo were documented in my latest book, as I was monitoring the signals almost daily for many enemy broadcasts. Much of the news as far as the axis powers were concerned, originated from these broadcasts.

By 1945 the United States Armed Forces were in Japan following the surrender and they set up an Armed Forces Radio Network which broadcast from WVTR and operated on several shortwave frequencies including 7552 and 9605kHz, in Tokyo. By 1947 broadcasting in Japan had come back to civilian control and the Broadcasting Corporation of Japan operated a key station JOAK, which sent its programmes for relay via shortwave frequencies to regional stations in Japan. BCJ programmes were broadcast from JOAK to the Japanese repatriation camps in the areas of Taihoku, Shanghai, Changchun, Peiping and Tientsin according to a letter from Tokyo.

Today, the Broadcasting Corporation of Japan is better known as NHK and the Domestic Service is in competition with commercial radio on AM and FM; but on shortwave there are two services. NSB the Nippon Shortwave Broadcasting Corporation commenced in 1952, and is received on its frequencies of 3925 and 3945kHz as well as other channels.

The NHK operated Radio Japan is also now well received world wide. It uses seven 300kW and four 100kW transmitters from the Yamata transmitting station and is also relayed by several overseas broadcasters including BBC Skelton, RCI Sackville, RFI Montsinery, Africa Number One Gabon, BBC Singapore and Ekala Sri Lanka.

The transmission to Australia is 0900 - 1000 on 11,850kHz and the General Service is heard 0700 - 0800 on the same frequency.

Sunspots and frequencies

The falling sunspots are expected to reach the bottom of the 11 year cycle in the next three months. This will mean that after that time, shortwave stations will begin to move to high frequencies.

A conference concerning the allocation of frequencies was held in Washington recently at the Voice of America. William Whittacker, VOA's frequency and Monitoring Manager discussed this point, and he feels that the last 11 year cycle has resulted in propagation of signals being better understood. Another area where stations are making certain of better frequency coordination is the broadening of the membership of the group as now all countries of the world are part of the process.

For the first time, countries in the former Eastern Europe are now also cooperating in frequency planning. The use of relay bases has also helped to improve reception and with transmitters in the former Soviet Union being leased to other broadcasters they are being assured of a clear transmission path.

Another area of discussion has been the use of satellites by international broadcasters. Many countries use this form of transmission to link their home base to relay stations in other parts of the world, while in some cases the satellite signal is also available for those listening in a home location. This is the case in North America and Europe, for example.

The coordination of the use of satellites has begun and a further conference is expected later in the year. Many stations are now announcing the satellite service they are giving.

For instance, Radio Australia programmes are carried for listeners in Europe on the ASTRA satellite twice daily at 0700 - 0800 and 1500 - 1600UTC, on the World Radio Network Service, and in North America, Radio Australia can be heard on the ASC 1 satellite. In Japan the service is available on Japanese CAN Cable Network. ❖

AROUND THE WORLD

ARGENTINA: Buenos Aires has been heard in English at 0200 - 0300 on 11,710kHz with a DX programme on Mondays. This is not a daily transmission as often the signal has been heard closing in Spanish at 0200UTC.

CUBA: Havana has been heard with Spanish music then signing off at 0500, followed by the National Anthem on 9475kHz.

ISRAEL: IBA has begun a new broadcast to Australia in Hebrew on Thursdays from 1200 - 1300UTC on 13,713kHz. The Director General of Contact and Coordination has written about this new transmission and is keen for reception reports.

KAZAKISTAN: The International Service of Alma Ata has an English service at 0630 - 0700 on 9560kHz with a variety of English features.

LEBANON: The Voice of Hope has been heard at 1830UTC on 6280kHz, with a request for reception reports to PO Box 77, 10292 Metulla, Israel. The station identifies as the Voice of Hope for the Middle East; a similar slogan is used by stations in this network to indicate the areas of operation.

NEPAL: Kathmandu has been heard with news in English at 1415 - 1425, then continues in local language to sign off at 1500 on 5005kHz. The station suffers interference from Malaysia.

PAKISTAN: Islamabad has English to Europe at 1700 - 1900UTC, now heard on 5825kHz which replaces 7295, and continuing on 11,570kHz.

SWITZERLAND: Swiss Radio International, Berne is now using 12,075kHz which replaces 11,640kHz. The station has English 0900 - 0930 and 1100 - 1130UTC also using 9885 and 13,685kHz.

USA: The new DX session 'Cumbre' is hosted by Marie Lamb, C/- WAER Radio, 215 University Place, Syracuse, New York 13244 - 2110, USA. The programme is best received on Saturday on WHRI, Southbend, Indiana at 0600UTC on 5760 and 7315kHz and from KWHR, Hawaii on Monday at 0330 on 17,510kHz. ◆

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Standard Time and 13 hours behind New Zealand Standard Time. ❖

APRIL DEALS FROM JAYCAR

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We have made a scoop purchase of a quantity of Micron Pulse count passive infrared detectors. The Micron PIRs are designed by an English company and manufactured in Asia. This unit is currently being sold to the installer market, at a price which is higher than what we can offer you. But remember, this is a once only deal, and cannot be repeated. Stock will not last.

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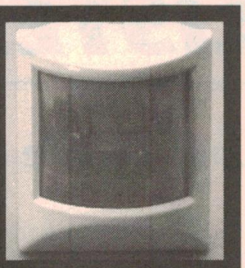

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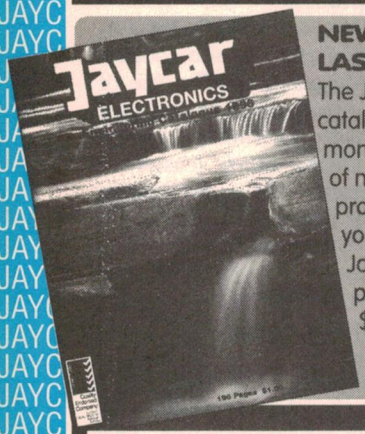

NEW CATALOGUE LAST MONTH

The Jaycar 1996 196 page catalogue was released last month. It includes hunderds of new and interesting products. If you haven't got your copy yet call into any Jaycar store or dealer and pick one up for $1, or send $2 to Jaycar, PO Box 185 Concord. 2137, and we'll post you one.

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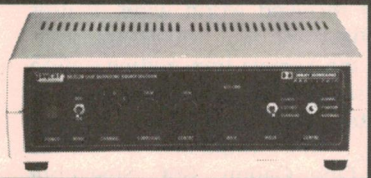

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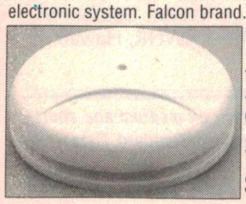

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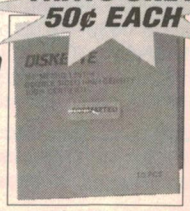

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140 Watt 12-240V Mini Size Inverter

NEW 96 in

This unit is made by the same company that makes our brilliant 200 watt inverter, so you know it will perform extremely well. It measures only 120L x 75W x 46H mm. It is supplied with a lead and cigarette lighter plug, and a 240V output adaptor plug, as pictured. •It has a power on LED indicator and offers good protection •Automatic overload shutdown •Automatic overpower shutdown •Short circuit protection •Low battery shutdown •After shutdown simply remove input plug from power and reinsert to restart.

Cat. MI-5036 **$99.95**

12V Halogen Downlight Holder

NEW 96 in

Install your own halogen lamps in the ceiling with this holder. Colour is white, complete with lamp base.

20W LAMP CAT SL-2730 $5.95
50W LAMP CAT SL-2732 $5.95

Cat. SL-2738 **$4.95**

FM WIRELESS INTERCOM

NEW 96 in

New model for 1996. Lower price. Was $99.50 PR. Simply plug into a power point. No wiring needed. Ideal for monitoring baby's room, garage to house etc etc.

Cat. AI-5500 **were $99.50** **$69.95pr**

CASE WITH HANDLE

NEW 96 in

This quality case was designed to hold a disk drive. It is ideal for test equipment. There is a handle supplied which attaches to one end, and also supplied are metal front and rear panels. Colour is black. Size 270(D) x 160(W) x 60(H)mm.

Cat. HB-5945 **$19.95**

Cellular Phone / Video Camera Battery Discharger / Deep Conditioner / Fast Charger

NEW 96 in

This charger does everything, and accepts the most common cellular phone batteries (adaptors are required at extra cost for each different battery). Suitable for both Ni-Cad and Ni-MH batteries. Features: •Display LEDs and beeper advise you how the charging is progressing. •When the battery is charged, unit switches to trickle charge. •Discharge/rapid charge mode: The battery will be discharged and then fast charged. •Deep conditioner cycle: This is for Nicad batteries that have the memory effect. The charger will automatically discharge and recharge the battery 3 times with a 30 minute break between the cycles. •Self test mode: Test the charger to ensure it is fully functional. •Temperature sensor: Automatically stops charger if the battery gets too hot. •Powered by 12VDC so unit can be used from cars power (cigarette lighter lead supplied) or can be used from mains power (use an existing plugpack or use Cat MP3006 12VDC 450mA $15.50). •Charger is supplied with adaptor for Motorola Microtac.

Adaptors For Other Batteries:

•Motorola Microtac: Supplied with charger •Motorola 8000/9000/9800 7.2V Cat MB-3555 •NEC P3/P300 6.0V Cat MB-3556 •Ericsson 237/337 6.0V Cat MB-3557 •Oki 900 6.0V Cat MB-3558 •Nokia 2110 6.0V Cat MB-3559 •Nokia 100/101/121 Coming soon

Please check for availabilty.

Video Camera Battery Adaptors:

•Sharp, Hitachi, Sony	Cat MB-3565
•Panasonic, Canon, JVC	Cat MB-3566

ALL ADAPTORS **$12.95 each**

Charger includes cigarette lighter lead. For 240V operation use an existing plugpack. Requires 12VDC 400mA or use Cat MP3006 $15.50.

CHARGER Cat. MB-3550 **$69.95**

CAR SUBWOOFER SLAYS THE OPPOSITION!!!

Jaycar RE/SPONSE

In issue No 25 of Hot 4s and Performance Cars, 10 x 10" subwoofers were tested. Brands included were MTX, Clarion, Earthquake, G&S Designs, Rockford Fosgate, JBL, Hi Fonics Zeus, Cerwin Vega, Soundsteam and our Jaycar CS2244 at $149 as a wildcard just to see how good a $150 woofer could be. The others ranged in price up to $309!! The following excerpts are lifted from the issue about the Jaycar. "It didn't disappoint". "Sounding out also surprised us as the RTA measurement shows the sub had a very smooth and even response inside my car". "It liked medium to loud levels". "DEFINATELY THE BEST VALUE OF THE BUNCH AND NOT FAR OFF THE BEST SOUNDING". "If you want to boom on a budget then look no further".

THE FULL RANGE OF JAYCAR RE/SPONSE 4Ω SUBWOOFERS.

Size Inch	Cone Material	Power Handling	Box Size Vented	Box Size Sealed	Cat No.	Cat Price
6"	Polycone	80WRMS	13LT	7.7LT	CS-2232	$49.50
6"	Carbon Fibre	80WRMS	21LT	10.6LT	CS-2240	$69.50
8"	Polycone	120WRMS	25LT	20LT	CS-2234	$65.00
8"	Carbon Fibre	120WRMS	25LT	20LT	CS-2242	$99.50
10"	Polycone	160WRMS	50LT	30LT	CS-2236	$99.50
10"	Carbon Fibre	160WRMS	55LT	35LT	CS-2244	$149.50*
12"	Polycone	200WRMS	105LT	67LT	CS-2238	$135.00
12"	Carbon Fibre	200WRMS	95LT	50LT	CS-2246	$185.00

*The driver referred to above

Jaycar RE/SPONSE

Car Immobilizer With Code Learning Keys

Features: •Code learning keys •3 separate disable circuits •Passive arming •Tamper memory •Arming memory •Car horn can be connected •LED mounted in key recepticle •More than 1/2 million key codes •Code Learning Keys: If you lose a key, then you can buy a spare at any Jaycar store and it will learn the code. •3 Separate Disable Circuits: All use black wires, so once the unit is installed remove the installation labels and would be theives won't know what is connected to where. Disable circuits are for ignition, starter and fuel pump. See 1996 catalogue for full details. Unit is supplied with: •Black box electronics with black disable circuit wiring •2nd wiring loom for horn and power •Key recepticle with built in status LED •2 code learning keys •Instructions and mounting hardware

SPARE CODE LEARNING KEYS CAT LA-8921 $19.95

Cat. LA-8920 **$129.50**

NEW 96 in

JAYCAR DISCONTINUED PRODUCT SELLOUT

MANY ITEMS BELOW COST:

Stock is limited, there may not be all items available in all stores. If your nearest store has sold out, they can advise you instantly which store has some left. Be quick. Goods not available at Dealers at these prices. See our 1995 catalogue for details on many of these prices.

Cat No	Description	Was	Now
AA-2040	Easi Ear Amplifier	14.95	7.95
AR-3256	EA-EB Ford Antenna	14.95	7.95
BC-1160	Book-Living On 12V Ample power	39.95	29.95
BC-1162	Book-Wiring 12V with Ample Power	29.95	22.95
BT-1380	Book-Photocopier Repair & Maintenance	32.95	24.95
BM-2142	Book-Learn Microsoft Word Now	19.95	5.00
BM-2486	Book-Satellite Cable TV	24.95	14.95
BB-7009	Book-Model Railway Projects	8.75	6.00
BB-7040	Book-Electronic Music Projects	13.95	8.95
BB-7303	Book-Electronic Hobbyist Handbook	9.95	7.95
BB-7405	Book-Microsoft Works Windows	16.95	9.95
BB-7406	Book-Intro to MS-DOS	8.75	4.95
BB-7415	Book-Advanced guide MS-DOS	11.50	7.95
BB-7420	Book-MS-DOS Explained	16.95	9.95
BB-7424	Book-Understanding PC Specifications	13.95	7.95
CM-2081	5" Midrange-Square Frame	26.95	17.95
CS-2275	6" 2way Car Split Speaker System	199.50	139.50
CX-2607	Car Crossover-2way 3khz Stereo	49.95	29.95
CW-2820	Wall Bracket for Speaker/Microwave etc	29.95	20.00
CW-2830	TV Wall Bracket with VCR Shelf	79.95	49.95
DC-3092	2 Pin CB Radio Power Lead	5.95	2.00
HP-0645	Bolt 6x16mm Pkt 12	2.95	.50
HP-0830	Large Plastic Foot	1.00	.50
HP-1151	TO3 Rubber Washer Pkt 100	25.95	15.00
HP-1352	Solder Lug Bargain Pkt 200	5.00	2.50
HM-3216	5 Way Launcher .1" Right Angle	.20	.05
HM-3828	Plastic Cabinet Corner	1.85	1.00
HK-7728	Slider Pot Knob	.50	.20
HP-9516	Double Side Fibreglass PCB 335x167	5.00	2.50
KA-1574	Kit 30V 1A Power Supply	89.00	69.00
KA-1660	Kit Electronic Fence	64.95	42.00
KA-1692	Kit Voice Operated Relay	24.95	14.95
KA-1737	Kit Speech Professor For Transmitter	29.95	20.00
KA-1749	Kit 50Mhz Frequency Counter	89.50	60.00
KA-1762	Kit Screen Saver for PCB's	14.95	7.95
KA-1772	Kit Digital Trigger - CRO's	55.00	32.00
KC-5028	Kit Train Controller	89.00	49.00
KC-5072	Kit Digital Voice Recorder	79.50	55.00
KC-5090	Kit Sinewave Oscillator	16.95	8.95
KC-5105	Kit Baby Monitor	24.95	14.95
KC-5125	Kit FM Radio Receiver	29.95	19.95
KC-5132	Kit Nicad Cell Discharger	27.95	16.95
KC-5169	Kit LW AM eather Receiver	32.95	19.95
KC-5170	Kit Twin Diversity FM Receiver	199.00	129.00
KC-5174	Kit 3 Spot Sine Wave Oscillator	59.95	39.95
KC-5180	Kit Oil Change Timer	17.95	7.95
LT-3185	UHF Phased Erray TV Antenna	69.95	49.95
LA-5050	Burglar Alarm Window Tape	19.50	14.00
LA-5060	Alarm Window Tape Blocks	1.00	.50
LA-5320	Bellmate 950 Home Alarm Panel	149.00	99.00
LA-5321	Bellmate 960 Remote Keypad For 950	49.95	29.95
MF-1090	240V to 115V 35W Step Down T/F	89.95	59.95
MP-3024	1.2A Regulated Power Supply 6,7.5,9,12V	55.00	39.95
MB-3501	Solar Charger for 2 x C/Sub C	16.95	10.00
NC-4256	Ammonium Persulphate 2.5kg	29.95	20.00
PM-0897	1xD25 Wallplate-Stainless	2.95	1.40
PM-0898	2xD25 Wallplate-Stainless	3.50	1.40
PA-0908	D15M to RJ12 Socket Adaptor	2.50	1.00
PP-0920	4 Pin Disk Drive Plug	1.50	.75
PI-6499	40 Pin W/Wrap Mahined IC Socket	6.50	3.50
QM-1240	Metex M3650 DMM-Computer	179.50	149.50
QM-1330	4.5 Digit DMM	99.95	69.95
QM-1440	Brymen BM323	159.00	79.00
QP-5040	MU65 Panel Meter 0-1mA	24.50	14.95
QP-5042	MU65 Panel Meter 0-100mA	24.50	14.95
RP-3814	500Ω Multi Turn Pot	7.95	2.50
RG-5195	Mkt/Poly Capacitor Pack-75 pcs	10.00	5.00
RQ-5260	Crystal 1MhZ	14.95	8.95
RQ-5264	Crystal 1.8432 MhZ	9.50	1.00
RQ-5269	Crystal 2.4576 MhZ	8.50	1.00
RQ-5277	Crystal 4.433619 MhZ	5.50	1.00
RQ-5280	Crystal 4.9152 MhZ	5.50	1.00
RQ-5294	Crystal 16 MhZ	4.00	1.00
RQ-5296	Crystal 18 MhZ	4.00	1.00
RC-5500	2uF 440V Modem Capacitor	2.95	1.50
RU-6742	1000uf 35V RG Can Electro	2.00	.50
RU-6743	1000uf 63V RG Can Electro	2.75	1.20
RU-6744	1000uf 100V RG Can Electro	3.50	1.50
RU-6745	2200uf 25V RG Can Electro	3.00	1.00
RU-6762	1000uf 100V RPPC Electro	2.50	1.20
SP-0726	Push Off Mini P/B Switch	1.60	1.00
SK-0954	Rocker Switch 240V 15A SPDT	3.50	.50
SK-0999	Rocker Switch Pack	12.95	5.00
SM-1025	10Way DIL Switch	3.00	1.20
SM-1026	12way DIL Switch	2.50	1.00
SR-1280	Mains Rotary on/off 3A Switch	2.95	1.00
SB-2332	D Batts Pkt 2 Vinnic	1.50	.75
SL-2637	Car Alarm Switch Globe short	1.50	.50
SL-2638	Car Alarm Switch Globe long	1.50	.50
SL-2641	MiniLamp 6V 200mA - Leads	.75	.20
SL-2740	Par 38 240V 150W Clear Globe	6.95	4.95
TS-1490	Scope 240V 25W Soldering Iron	32.95	23.95
TS-1710	Hot Sol Flame Tip	2.00	1.00
TS-1720	Small Soldering Iron Stand	3.95	2.00
TD-2480	Mini Engraver	17.95	10.00
WB-1603	6 Core Phone Cable Flat	.65/m	.20/m
XC-0110	CD DeskClock	19.95	5.00
XC-4625	CD ROM - Dual Speed	145.00	100.00
XC-4682	Disk Box for 10 x 5"	3.25	1.50
XC-4750	Sony Disks 3.5" DSDD Box 10	17.95	10.00
XC-4750	Sony Disks 3.5" DSDD Formatted	19.95	12.00
XC-5064	Computer Switch Box 2 Way Centronics	29.95	17.50
XC-5142	Tower Case Dust Cover	5.95	2.95
YX-2507	60mm Fan Guard	2.95	1.00
YT-6044	Phone Lead US Plug to Aust Socket 5m	12.95	7.95
YT-6062	HPM 2 x RJ45 Wall Socket	7.95	2.95
YT-7040	Uniden Cordless Phone	229.00	150.00
ZR-1036	6A 1000V Stud Diode	2.50	.50
ZV-1605	LM309K Voltage Regulator	4.50	2.50
ZT-2325	2N3643 NPN Transistor	.80	.20
ZZ-8419	Used 4116 RAM/D2118	.50	.10
ZZ-8459	2732A EPROM 450ns	11.95	6.95
ZZ-8464	2764 EPROM	8.95	4.95
ZZ-8468	27128 EPROM	11.95	6.95
ZZ-8469	27C128 EPROM	9.95	4.95
ZZ-8470	27256 EPROM	11.95	5.95

Cellular Telephone Batteries

At last, we have a range of the most popular cellular telephone batteries & cases. The batteries use Japanese cells and are assembled in Taiwan.

Nokia 100

- Ni-Cad - Capacity 1000mAH
  Cat. SB-2550 **$69.50**

Nokia 101/121

- Ni-Cad - Capacity 800mAH
  Cat. SB-2552 **$69.50**
- Nickel Metal Hydride NI-MH
  Capacity 1100mAH
  Cat. SB-2554 **$79.50**

Nokia 232

- Ni-Cad - Capacity 1000mAH
  Cat. SB-2556 **$69.50**
- Nickel Metal Hydride NI-MH
  Capacity 1100mAH
  Cat. SB-2558 **$79.50**

Motorola 4800

- Ni-Cad - Capacity 1400mAH
  Cat. SB-2574 **$69.50**

Nokia 2110

- Ni-Cad - Capacity 1100mAH
  Cat. SB-2560 **$59.50**
- Nickel Metal Hydride NI-MH
  Capacity 1500mAH
  Cat. SB-2562 **$89.50**

Ericsson 337

- Ni-Cad - Capacity 1100mAH
  Cat. SB-2578 **$69.50**

NEC P3

- Ni-Cad
  Capacity
  700mAH
  Cat. SB-2580 **$59.50**

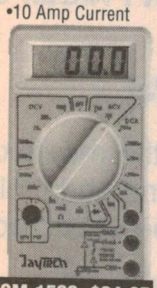
Motorola Microtac

- Ni-Cad - Capacity 700mAH
  Cat. SB-2568 **$59.50**
- Nickel Metal Hydride NI-MH
  Capacity 1100mAH
  Cat. SB-2570 **$69.50**

AMAZING VALUE DMM'S FROM JAYCAR

BRILLIANT RANGE OF MULTIMETERS ALL OFFER UNBELEIVABLE VALUE FOR MONEY
For full specifications and list of all the features associated with each model see our 1996 catalogue.

Low Cost
- 3.5 Digit 12.5mm High Display LCD
- Transistor Test
- Diode Test
- 10 Amp Current



QM-1500 $24.95

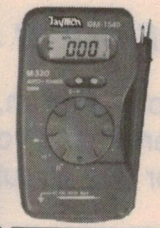
Pocket
- 3.5 Digit
- Wrap around leads
- Small size
- One hand operation
- Continuity • Diode

QM-1520 $34.95

30 Range
- Large Display
- Transistor Test
- Diode Test
- Holster

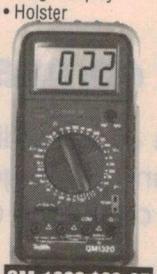
QM-1300 $49.95

Pocket Autorange
- 3.75 Digit • Datahold
- Wraparound leads
- Buzzer • Diode test



QM-1540 $49.95

Temperature
- Frequency, Transistor
- Diode, Continuity
- Capacitance
- Auto Power Off
- Large Display
- Holster



QM-1320 $69.95

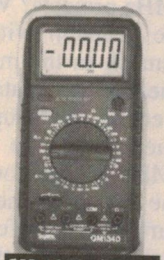
Dwell Tacho
- RPM
- Ohms
- Volts
- Holster

QM-1430 $69.95

Autorange
- 3.75 Digit
- Capacitance
- Frequency • Buzzer
- Bargraph • Transitor
- Holster • Data Hold

QM-1530 $89.95

4.5 Digit
- Frequency • Transistor
- Capacitor • Data Hold
- Buzzer • Holster



QM-1340 $99.95

Metex RS232
- Dual Display •Temp
- 40MHZ Freq • Plus more
- Includes Computer Interface

QM-1260 $239.50

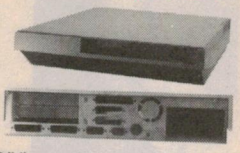
Protek 506 RS232
- Inductance • True RMS
- Dual Display
- Recording + more
- Computer Interface

QM-1290 $289.00

Brymen 837
- DC & AC True RMS
- Dual Display
- dBm & dB
- Recording
- Plus More

QM-1460 $399.00

Bargain Computer Case



See July ads for full details. Size 360(D) x 340(W) x 70(H)mm. Mail order customers add extra $4 due to weight.

Cat. HB-5100

Was $20 ONLY $5

Ultra Quality Stereo Earphones

The BEST earphones we have listened to. They are expensive, but if you want amazing sound from your Walkman / Discman, these are it.
The 19mm cobalt speakers have a lot to do with the sound quality, as lower cost units use mylar speakers, or even transducers.
Supplied in a plasitc carry case and gold 3.5mm stereo plug.

Cat. AA-2030 **$22.95**

Recordable CD

CD-R 74 minutes. Capacity 650mB. Mitsubishi brand - made in Japan

Cat. XC-4710 **$21.95**

NEW KIT!!!

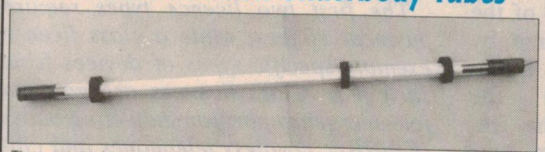
Subwoofer / Bridge Adaptor Kit For 12VDC

REFER: EA MARCH '96

This is an active subwoofer filter or amplifier bridging adaptor, and will operate from a single 12VDC supply making it ideal for use in car sound systems. It will accept either RCA line levels or speaker output levels and has a frequency response down to zero hertz. The kit is supplied complete with case, PCB, silkscreened front panel, RCA sockets, plus all electronic components.

Cat. KA-1784 **$22.95**

12V Coloured Neon Underbody Tubes

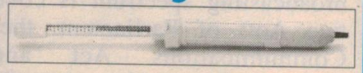


These neon tubes are designed to be mounted under the car, or wherever you like. The tube is neon, and is encased in hardened plastic. Mounting cushions and clips are supplied. Total length is 950mm. Diameter is 26mm. Four colours are available. Ideal for store displays, bedrooms, discos etc. Draws approx 350mA at 12VDC.

Blue	Cat. ST-3120	Pink	Cat. ST-3122
Green	Cat. ST-3124	Purple	Cat. ST-3126

$49.95ea

Deluxe Antistatic Desoldering Tool



If you desolder a lot, and want the best hand tool available, then try this unit. Its suction power is immense, the vacuum chamber itself is almost twice as large as our other models. Supplied with antistatic desolder tip. A quality hardworking tool. Total length 325mm.

Cat. TH-1865 **$24.95**

ANTISTATIC REPLACEMENT TIP
Cat. TH-1866 $4.95

Jaycar ELECTRONICS

HEAD OFFICE
8-10 LEEDS ST RHODES 2138
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FAX: (02) 743 2066

Quality System — Quality Endorsed Company ISO9002 Lic 6143 Standards Australia

WHOLESALE
PHONE: (02) 743 5222
ORDERS: 1800 620 169
FAX: (02) 743 3070

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IN AUST (up to 20kg) $14.00

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FREE CALL - ORDERS ONLY
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HOTLINE (02) 743 6144

MasterCard. eftpos AMERICAN EXPRESS VISA Cards Welcome

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BURANDA QLD •144 Logan Rd•Ph:(07) 3393 0777•Fax:(07) 3393 0045 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm

CANBERRA ACT •11 Kembla St. Fyshwick•Ph:(06) 239 1801 •Fax:(06) 239 1821•Mon/Fri:9-5.30•Sat:9-1pm

COBURG VIC •266 Sydney Rd•Ph:(03) 9384 1811•Fax:(03) 9384 0061 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm

MELBOURNE CITY •Shop 2,45 A'Beckett St•Ph:(03) 9663 2030•Fax:9663 1198 •Mon/Fri:8.30-5.30•Fri:8.30•Sat:8.30-4•Sun:10-4pm

SPRINGVALE VIC •887-889 Springvale Rd Mulgrave. Nr Cnr. Dandenong Rd •Ph:(03) 9547 1022•Fax:(03) 9547 1046 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm

SYDNEY CITY •129 York St•Ph:(02) 267 1614•Fax:(02) 267 1951 •Mon/Fri:8.30-6pm•Thurs:8.30pm•Sat:9-4pm

BANKSTOWN •363 Hume Hwy Cnr Meredith St•Ph:(02) 709 2822•Fax:(02)709 2007•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4•Sun:10-4pm

GORE HILL •188 Pacific Hwy (Cnr. Bellevue Ave)•Ph:(02) 439 4799•Fax: (02) 439 4895•Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4•Sun:10-4

NEWCASTLE •830 Hunter St. (Cnr Stewart Ave)•Ph:(049) 653 799 •Fax:(049) 653 796 •Mon/Fri:9-5.30 •Sat:9-4pm

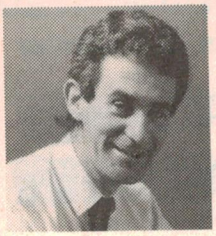
PARRAMATTA •355 Church St (Cnr. Victoria Rd)•Ph:(02) 683 3377 •Fax:(02) 683 3628•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4•Sun:10-4pm

PENRITH •199 High St•Ph:(047) 21 8337•Fax:(047) 21 8935 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm•Sun:10-4pm

PERTH •326 Newcastle St Northbridge•Ph:(09) 328 8252 •Fax:(09) 328 8982 •Mon/Fri:9-5.30•Sat:9-4

RHODES •8-10 Leeds St•Ph:(02) 743 5222•Fax:(02) 743 2066 •Mon/Fri:9-5.30

POST & PACKING $10 to $24.99=$4.00 $25 to $49.99=$5.00 $50 to $99.99=$7.00 OVER $100=$8.00



INFORMATION CENTRE

by PETER PHILLIPS

Using 304MHz, speaker comparisons and high prices

This month we start with a discussion of the radio spectrum, followed by a look at the merits of speaker comparisons. There's questions about generating your own mains power, and about old TV transformers; also a reader has a complaint or two about high prices for hard-to-get components, and more...

These days we are all much more resource conscious, but I wonder how many people view the broadcast frequency spectrum as a finite resource. It's an abstract thing, and a resource we have been using for less than 100 years.

Yet we have already exceeded its limits, and authorities around the world are looking at ways of reducing our dependency on the airwaves.

It's a pretty reasonable likelihood that free-to-air TV broadcasting will become a thing of the past when cable TV is firmly established, thereby freeing up some of the spectrum for other uses. Pundits are suggesting this will happen in Australia by 2020.

In Australia, the management of the broadcasting spectrum is covered by two Acts of Parliament, the Radio Communications Act and the Broadcasting Services Act. The frequency range covered by these Acts extends from 9kHz to 420GHz (G = giga = 10^9). Hobbyists and amateurs have always sought their share of the spectrum, and battles have raged over the years as to who can use which frequency allocations.

Of particular interest to many people is 304MHz. Over the years we, and many other electronic magazines around the world, have described a number of 304MHz UHF remote control systems, and components for these, like 304MHz SAW resonators are readily available from most electronic stores. So imagine our response to this letter, which comes from a reader who works for the Spectrum Management Agency. This agency is the watchdog for our use of the frequency spectrum, and employs over 400 people. It's based in Canberra, but this letter comes from the Melbourne branch.

304MHz

EA has had several articles over the past few months dealing with the law relating to connection of devices to the public telephone network. Austel, the governing body, has been given a high profile in these articles, and rightly so.

In an article in Information Centre (Dec '95) you mention, no promote — the use of 304MHz for use in a phone link. This surprises me a little, as I'm sure the technical and editorial staff of your magazine are fully aware of the Radiocommunications Act 1992. This Act makes provision for use of the radio spectrum through three types of licences: spectrum licences, apparatus licences and class licences.

The first two licence types require payment of fees, while a class licence exempts specific types of devices from such fees. Class licences are gazetted for emergency position indicating buoys (EPIRBs), cordless telephones and citizens band radio service (CBRS) equipment, plus a few other devices. An assortment of devices are covered by a separate class licence for 'low interference potential devices' (LIPDs). Included with this fax is a copy of the class licence for LIPDs.

Item 15 of the Schedule for LIPDs calls up five sub bands between 225MHz and 399.9MHz, with a maximum effective isotropic radiated power (EIRP) of 10uW. 304MHz is not included in these sub bands. Item 28 however does cover 304MHz and says: alarm transmitters, (including security and personal safety transmitters) — 303.95 to 304.05MHz, 100uW EIRP.

Clearly a phone link is not an alarm, security or personal safety transmitter, which is why I question your promotion of the use of 304MHz. I can only assume it may be in ignorance of the law, and if so I'm happy to be of assistance. (Russell Williams, SMA, Melbourne Area Office.)

After reading Russell's fax, I realised this issue had some far reaching implications. What about the many other 304MHz projects? Were these illegal?

The problem with 304MHz is that it's smack in the middle of a range of frequencies allocated to the Defence services. Legal duplicate use of any frequency in the range of 273 to 312MHz is therefore very limited and is the result of negotiation with the Department of Defence.

So this raises the question of all those garage door openers and other 304MHz based projects. At best they're illegal, unless their use conforms to that specified in item 28, and worse they may be endangering the defence system of the country.

We spoke to Russell, but given the contentious nature of the enquiry, he referred us to others in the Agency for further clarification. It seems there's no simple solution, but some hope is provided by item 16 in the aforementioned schedule. This item refers to all transmitters, but it specifically excludes the frequency range of 303.95 to 304.05MHz, the band covered by item 28. As well, all frequencies in item 16 have a maximum EIRP of 10uW.

Of course, it's unlikely any home constructor will be able to determine the exact operating frequency of a 304MHz UHF system, so theoretically if its operating frequency conforms to item 16, and its output power is l0uW or less, all is well, regardless of its application.

However, it's clear we need to be careful in our use of this frequency. As far as we can tell, the UHF projects we've presented in recent years have an output power of less than 10uW anyway, and a range of no more than 100

metres. As well, they all have a very short duty cycle (transmission of a coded pulse train), which is rather similar to that from an alarm transmitter.

So thanks Russell, for writing, and to all those at SMA who contributed the information I needed to answer Russell's letter. Incidentally, an excellent publication available from the SMA is the *Australian Radiofrequency Spectrum Plan*. It includes general information and a Table of Frequency Allocations, which is the actual spectrum plan. The contents of the Table are legally binding on the SMA in making decisions on the use of the frequency spectrum, and are determined by the International Telecommunication Union (ITU).

The ITU meets every two years and is a huge gathering of people from almost every country in the world. Australia sends a contingent to this meeting, and you'll notice in the Plan footnotes if a country uses a frequency for a different purpose to the agreed worldwide use. Australia's unique use of 304MHz is explained in a footnote.

Speaker systems

We haven't talked about speaker systems in this column for some time, and the following letter offers a few points worth considering...

I've always understood that the ideal speaker system reproduces (in sound) the electrical signal fed to it. To this end the enclosures should be acoustically neutral, as they were in days of old. Yet I have before me a speaker system using a 10" woofer in a 64-litre bass reflex enclosure made from 16mm veneered particle board.

Perhaps I'm missing something, but when the 1812 Overture comes through at 100 watts, I suspect the panels will be hard-pressed (pardon the pun) to contain the cannons.

Compare these with your EA 'Hobart's, which if my memory holds true, specified 25mm MDF. Whether MDF or particle board is unimportant, the extra 9mm to contain a smaller driver is the main point. But perhaps box resonances are good these days!

While on the subject of speakers, how does the idea of a Grand Speaker Comparison sound to you? You could use the Hobarts as a reference and go back as far as the Magnavox 8-30/8MVs in a 2/3 way configuration. Indeed these speakers would have to be one of the early classics of EA/ETI.

The speakers could be classified by type/size and rated for overall efficiency, response and listening pleasure; the latter parameter by persons of technical as well as musical appreciation. Louis Challis springs to mind as an ideal candidate. I realise the logistics would be a nightmare, but I'm sure the challenge would be worthwhile.

There must be dozens of people who'd cheerfully loan their pride and joys for an honest appraisal and mention in your magazine. (James Longmire, Gosnells, WA.)

I assume you mean a comparison of home-built speaker systems only, James, including those developed by *EA*. Otherwise we would be testing for many years! I agree the logistics would be a problem, and I also wonder about a suitable venue. But more importantly, I wonder at the validity of speaker comparisons in general. Let me explain...

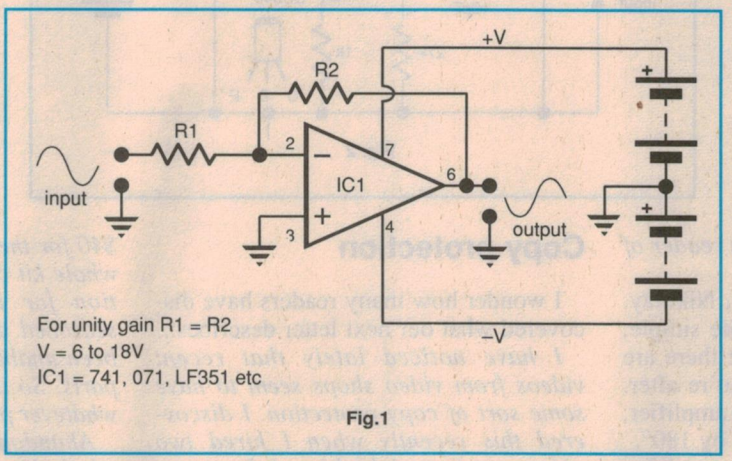


Fig.1

Three years ago I decided to spend some money on my sound system, including purchasing a new set of speakers. I took three CDs to the various hifi shops: Joan Sutherland arias, Mahler's 2nd Symphony and a recording of the Tannhauser Overture played (by David Drury) on the Sydney Town Hall organ.

I found no conventional speaker system able to satisfy the demands of all these discs, including a set priced at $15,000. I detected resonances, peaks and coloration that made one or more of the tracks sound different to how it should when played live. You see, I attend a lot of live concerts and I know how things sound when there's no amplification or electronics to get in the way.

I finally settled for a pair of Magnaplanar speakers, which are similar to electrostatic speakers in sound quality, as they are not in an enclosure. These speakers can't deliver the high sound level needed by some movie music and pop music. But at least the sound is uncoloured, spatially correct, and I can listen for hours without acoustic fatigue.

My point is, the things I look for may not be important to other listeners, who instead look for things I'm not interested in. And who's to say what's important? For instance, I'm told there's been pressure put on the ABC to amplify symphony orchestra concerts, as some members of the audience want a more 'punchy' sound, like they get from their sound system!

Many audiophiles look for speaker characteristics that collectively produce a sound they find satisfying, even if the sound is different to that of the live performance. In other words, it's a rather subjective and personal thing, depending a lot on the type of music and the attitude of the listener. I've found over the years that I can enjoy music on virtually any sound system, providing I like the music and the way it's performed.

In other words, I tend to listen to the music, and not the system. Of course, my enjoyment is enhanced if the system produces a natural uncoloured sound; but for the best sound, I attend live concerts, as I've yet to find a system able to compare with that. Yet others think the live sound is second best to a sound system. So who's right?

I believe speakers are a very personal thing, best chosen by the person who is going to spend hours listening to them, and not by a judging panel. For this reason, I never read reviews of speakers, no matter how learned the reviewer...

Getting off my soap box and back to the subject, I agree a speaker comparison such as you propose would be interesting and no doubt produce some worthwhile results. Unfortunately I doubt if we have the resources or time to organise it. Still, James, thanks for the suggestion.

Regarding your comments about speaker boxes, I totally agree that 16mm particle board is unlikely to be a good material for a large speaker enclosure, unless it is very well braced. Even a small box would need bracing for best results, but as you say, speaker box resonances might be seen by some as an enhancement.

Radiograms of the 1950s and 60s usu-

ally had a 12" speaker mounted on an infinite baffle (enclosure with an open back), and the open air resonance of the speaker was essential to maintain a decent bass sound.

Mirror reverse

Although he doesn't say, I think the next letter is from a young reader anxious to develop a circuit that — well, I'll let the writer explain.

Hi, my name is Nikolay and I have been trying to figure out how to make a circuit that will make exact mirror images of an analog signal. For example, if the input is a sine wave, the output should be a sine wave that's upside down.

If you can help me, or if other readers of EA can help, please do. All I need is the circuit and the values of the components. I'm always a reader of Info Centre.

Thanks for the compliment, Nikolay. The circuit you're after is quite simple, you'll be glad to hear. In fact there are many ways of doing what you're after. What you need is an inverting amplifier, or one that changes the signal by 180°.

In basic terms, an inverting amplifier changes the polarity of the signal, so if the input has a positive polarity, the output signal is negative. Because you want an exact but inverted replica of the input signal, the amplifier should have a gain of one, called unity gain. That is, feed in +1V and the output is -1V.

The simplest way is to use an op-amp and two resistors, as in Fig.1. The choice of op-amp is not important, and can be any of the common types, like the 741, 071 and so on. You can even use a dual or quad op-amp IC, by simply using only one of the op-amps on the IC. This lets you use ICs like the 072, 324 and 074. The circuit diagram shows the pin numbers for the 741 etc.

A disadvantage of using an op-amp is the need for a dual polarity power supply, as shown by the two batteries in Fig.1.

A transistor amplifier, like that in Fig.2 will do the same thing, but the difficulty is to get the gain to exactly one. The potentiometer in Fig.2 lets you adjust the gain, but you might need an oscilloscope to get the setting correct.

The transistor can be any NPN low signal type, like the BC548 shown. So it's quite simple really, just a handful of parts that should cost less than $5 from any component store. I haven't built these circuits, but they should give you the results you're after. You might have to fiddle the value of some of the components for optimum results.

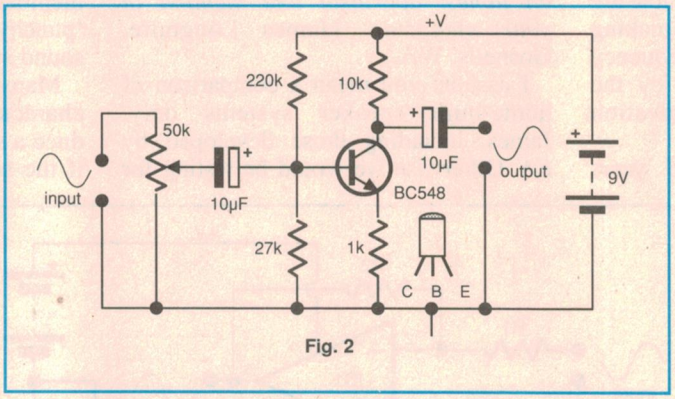


Fig. 2

Copy protection

I wonder how many readers have discovered what our next letter describes...

I have noticed lately that recent videos from video shops seem to have some sort of copy protection. I discovered this recently when I hired two videos on overnight hire. I have two Panasonic FS90 S-VHS video machines linked together, and after watching one video I decided to record the other to watch it later.

On replaying the recorded video I was greeted with a normal picture for 12 seconds, followed by some three seconds of loss of sync and colour. This then continued for the rest of the recording. After much research I've found only some brands of videos do this, including CIC and Roadshow. The originals are fine, but copies just don't play.

I have been a keen reader of EA cover to cover for 10 years now, and I don't recall seeing anything about copyright protection for videos. Perhaps you can clarify the subject. (Craig Price, Hervey Bay, Qld.)

I have no technical information about this, but copy protection of the type you describe has been around for some time. As far as I know, the sync and colour information is recorded at a reduced signal level, adequate for a TV, but hopeless once it's copied to another video tape. The aim of such a copy protection system is obvious, but it catches honest folk like you, Craig.

We can't get into such a minefield, as copying videos is (I assume) illegal, whatever the reason. I guess all you can do is re-hire the video. Sorry.

Component costs

Our next letter raises a complaint about the cost of electronic components, particularly those that are not readily available:

I am currently building the Stereo Sound Receiver project published in EA Jan/Feb 1995. Since I already have most of the parts, I decided to gather the remaining parts myself, instead of buying the whole kit for $249 from DSE.

I was surprised when I was quoted $111 for the Murata tuner module and $40 for the HWA IF module. Seeing the whole kit costs $249, I see no justification for these high prices. I have searched all over Australia, and have been unable to locate these two crucial parts. So it appears I will have to pay whatever price DSE deems fit to charge.

Abandoning the project or buying the whole kit is not an option, as I have already invested time and money. My question is, can I get these expensive parts anywhere else. Surely there must be a distributor for these parts. If not, can other tuner or IF module be substituted in the design. I would appreciate your comments, and I think quite a lot of do-it-yourself people have been caught by unreasonable prices for hard-to-get parts. (Michal Mienik, Morphett Vale, SA.)

As far as we know, Murata components are handled in Australia by IRH Components, but DSE are the importers of HWA Lin components. The ethics of charging what you consider to be an excessive price is a topic that can fill many pages, as anyone who has bought car parts will know. If you think a company is ripping you off, it's probably best that you let the company know, in writing.

It may be the import price is high, or perhaps DSE has to make special arrangements to supply such 'special items' in one-off quantities. We can't comment, as we don't know the facts. I've included your letter to give DSE the

opportunity to respond if there are enough complaints.

However, we might have an alternative that will suit you. In EA February '96 (page 79), I included a letter from a reader anxious to use parts from an old TV set in this particular project. You'll notice that I discuss using an existing TV set to perform the tuning function, which means you don't need to buy the bits that are so costly.

Jim Rowe (the designer of the decoder) agrees with my comments, so if you can integrate it into a TV set, you'll get around the problem.

Transformer impedance

Old TV sets are an excellent source of components, although when it comes to transformers, there's often not enough information on them to tell you much about them, as our next writer laments.

I have a number of valve TV sets which I am stripping down for parts. However I'm wondering if you can help me identify a few things concerning the power and speaker transformers in these sets.

I want to know which winding is the one nearest the core. Is it the primary or the secondary? Also I have a C-core power transformer, with the windings wound side by side, separated by insulating discs. It's easy enough to see (on all these transformers) which winding is for the filaments, but it's very difficult to tell between the high voltage secondary and the primary windings.

Can you also tell me what is the approximate current rating for the heater winding, as I want to use one of these transformers to power a low voltage soldering iron.

Concerning the speaker transformers, I notice some have an impedance value stamped on them, but most don't. Is there any relationship between the DC resistance of the windings and their impedance? (Harry Caesar, Ravenshoe, Qld.)

It's difficult to generalise, Harry, but the primary winding is usually the one nearest the core in most TV power transformers. However you can use a simple test to tell the difference between the high voltage secondary and the primary windings. First identify the filament winding, which has heavy gauge wire and usually gives an output of 6.3V.

As shown in Fig.3, apply 240V through a 40W 240V incandescent lamp to the windings you think are candidates for the primary. This way if there's something wrong, the lamp will light and prevent blown fuses and other potential disasters if the transformer is faulty, or if your guess about the winding is wrong.

When 240V AC is applied to the correct winding, the filament winding will give 6.3V (or so). As well, the lamp should hardly glow. The technique of using a lamp connected in series with the mains is useful for many tests, and I have one in my workshop permanently set up for such purposes.

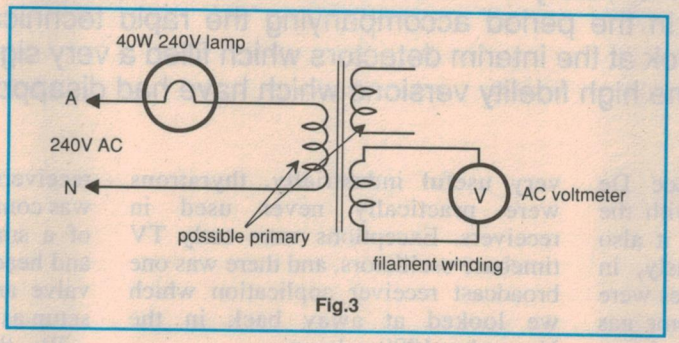


Fig.3

The current rating of a typical filament winding is around 5A, although you might get more if the other windings are not being used. However a TV transformer is not suitable to operate a Scope style soldering iron, as the current taken by the carbon heating element in the iron is usually well over 30A.

The impedance of a speaker transformer usually has no relationship to the DC resistance of the windings. Instead the impedance of a transformer is related to the turns ratio of the primary and secondary windings. From memory, speaker transformers from valve TV sets often have a 5k ohm to 8 ohm transformer. Others might have a 10k primary, with an 8 or 16 ohm secondary.

The plate impedance of a typical pentode is around 5k to 10k ohms, and the purpose of the transformer is to transform the speaker impedance up to that of the plate impedance. To be honest though, I've never found a good use for old speaker transformers, other than their original use.

240V power system

Over the years a number of readers have asked questions or given information about alternative power systems that generate 240V AC for use in a home or caravan. Our next contributor is seeking advice about such a system:

I don't have a lot of technical knowledge about electronics, although I've worked in the field for some 10 years. I have a block of land that is not supplied with electricity and I want to rig up a system to generate my own 240V mains AC power. I want to use solar panels, wind generators etc., to charge batteries that then supply suitable inverters.

However charging batteries this way means I have to check all the time that they are not overcharging or feeding into each other.

Should I go for 12V DC or 24V DC, and what current can I take from these batteries? Also are there such things as 12V circuit breakers? Can you give me any advice on all this? (Charles Collins, Belgrave, Vic.)

Being a city slicker, I am no expert on alternative power generation. As far as I'm aware, a 24V DC system is preferred when you are using batteries to power a house. A possible regulator is described in the Nov/Dec '94 issues of *EA*, in an article called Intelligent Solar Battery Charger. A dual 12V battery manager system is described in Jan/Feb '96 in a project article called Smart Dual 12V Battery Manager, which might help solve feedback problems. Unfortunately both these projects are for 12V systems, but they might give you some ideas.

I suggest that whatever you do it's going to be expensive, as you need to generate and store quite a lot of power. Perhaps a few country readers with such a system could enlighten us on what's really involved.

What??

I've at last got a few more questions, sent to me by readers. Thank you all. More questions are, of course, very welcome and needed, please. This month's question comes from Graham Pratt, of Hampton Park in Victoria:

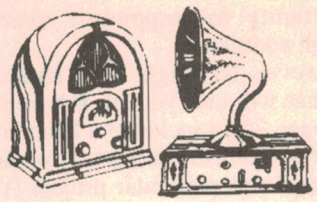
You are going shopping at the local computer swap meet. When you get there, you find someone selling hard drives for $10, motherboards for $2 and keyboards for 25c. What a bargain! But the catch is you must spend exactly $200 and you must buy exactly 100 items. You must also buy some of each item. What do you end up purchasing?

Answer to March's What?

The answer is Jones and Smith, but not Brown. ❖

Vintage Radio

by PETER LANKSHEAR



Alternative detectors

Last month we followed the history of the diode detector, its supersession by the triode, and its progressive re-adoption in the period accompanying the rapid technical developments of the 1930's. This month we look at the interim detectors which filled a very significant phase of receiver development, and some high fidelity versions which have had disappointingly few commercial applications.

Although the American Lee De Forest is popularly credited with the invention of the triode valve, it also appeared, almost simultaneously, in Britain and Europe. These valves were 'soft' in that they contained some gas and were really only suitable as detectors, and it is clear that De Forest himself had little idea how his 'Audions' worked. He was convinced that some gas was essential to their operation.

These first valves were very different from their high vacuum successors. They were operated with only a few volts of high tension, the limiting factor being 'blue glow' — the point where ionisation occurred. Because of this they can be regarded as the parents of the thyratron, which is the 'hollow state' analog of the silicon controlled rectifier.

In operation, thyratrons remain non conductive until a triggering signal is applied to the control grid. They then conduct heavily, regardless of the grid voltage, until the HT supply is interrupted or becomes negative. Although very useful industrially, thyratrons were practically never used in receivers. Exceptions were early TV timebase oscillators, and there was one broadcast receiver application which we looked at away back in the November 1989 column.

This was in the control system of the remarkable Philco 'Mystery Control' receiver — with what, for its time, was a very sophisticated remote control system.

But back to the soft valve as a detector. It was capable of very sensitive operation, but was erratic. The quantity of gas was critical and it tended to be absorbed by the valve internals. Incredible as it may seem, a popular method of releasing some of the occluded gas was to heat the valve envelope with a lighted match. Some valves had an appendage containing a wad of asbestos specifically intended for application of a flame! In those far off days, radio could be more of an art than a science...

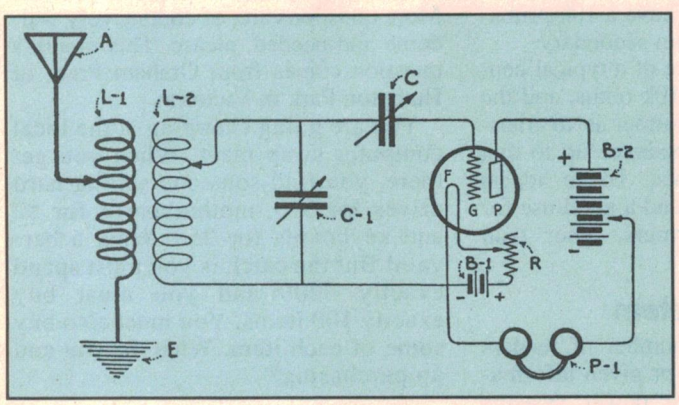
The basic circuit of these valve receivers was simple enough. A tuner was connected to the valve grid by way of a small capacitor. An HT battery and headphones were connected to the valve anode, to complete the simple setup as in Fig.1.

By the time broadcasting commenced in the early 1920's, with one exception the soft valve had given way to the high vacuum triode. The exception was the RCA UV200A, an optional plug-in replacement for the standard UV201A. The gas used was argon, and fortunately the valve did not require periodic warming!

Grid leak necessary

When high vacuum valves were tried in the standard detector circuit, operators found that the signal would 'block' or choke up. This was caused by a charge of electrons building up on the grid, as a result of the rectifying action between the filament and the grid.

The remedy was simply to provide a high resistance path of several



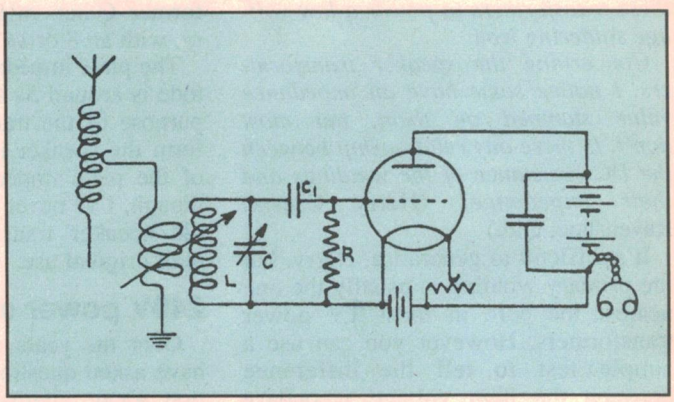


Fig.1 (left): Taken from a 1919 textbook, a typical detector using a 'soft' vacuum valve. There was no grid leak and the grid capacitor was commonly variable to optimise performance. Fig.2 (right): The traditional grid leak detector, a hard vacuum valve version of Fig.1: This circuit was copied from the 1925 Admiralty Handbook.

Fig.3: The convenience of plug-in resistors and grid leaks appealed to experimenters as this advertisement copied from a 1929 magazine shows. The prices were astronomical compared with today's values.

megohms, from the grid to the filament, so that the electrons could 'leak' away as in Fig.2. What better name for this resistor than the 'Grid Leak'? Often it was the only resistor in a battery powered receiver. A popular gag was to build a little trough to hang from the resistor, to catch any 'drips' from the leak!

Grid leaks were often just a pencil line drawn across the capacitor case itself, and could be adjusted with the aid of an eraser! Experimenters loved to try and optimise the value of the grid leak, and commercial versions were frequently made by enclosing a carbon-coated piece of paper in a glass tube with metal ends. These were often fitted to clips on the grid capacitor for ease of changing (Fig.3).

Practical values varied from about 0.5 megohms to 5.0 megohms or even more. With the higher values of grid leak the detector is most sensitive, but overloads readily; whereas with lower values, stronger signals can be handled.

As is sometimes the case with simple electronic devices, operation of the grid leak detector is much more complex than at first appearance, and was only fully worked out after it had come into general use. Fig.4 shows the fundamental circuit. It consists of a diode detector direct-coupled to a triode amplifier; but in practice there is no separate diode as the control grid itself doubles to perform this function.

The grid leak resistor can be connected to the cathode end of the tuned circuit, as shown, or more commonly, to the grid. But either way, the operation is the same. The diode rectifies the incoming RF signal, charging up the capacitor to the peak voltage of the carrier. In a practical circuit the reactance of this capacitor is for audio frequency variations, which are consequently not smoothed out, and the modulation component is transferred to the grid — to appear as an amplified signal at the anode.

Meanwhile, the rectified RF component of the signal varies with and is proportional to the strength of the incoming signal. This appears as a negative bias on the valve grid and is obviously greater for strong signals than for weak.

With a small signal, therefore, the grid has very little bias, and conversely with a powerful signal, the bias is very large, practically cutting off the anode current. The valve does not operate under optimum conditions, and by modern standards the grid leak detector has high distortion. Since about 1930 they have been used only in inexpensive receivers or for communications work.

The great advantage of the grid leak detector is that it is the most sensitive. But its shortcomings are serious distortion and also loading of the tuned circuit, which reduces selectivity.

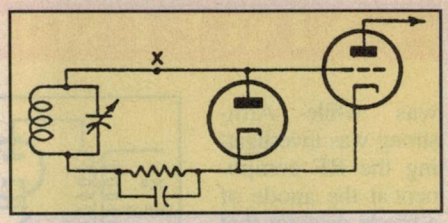


Fig.4: A grid leak detector is in effect a triode shunted with a diode. In practice, the diode is created by the grid itself. The grid capacitor and leak are usually inserted at point X.

Something for nothing

The grid leak detector remained popular long after its time with generations of experimenters, because of its association with the regenerative detector. The great and eventually tragic American radio pioneer Edwin Armstrong is generally credited with discovering regeneration, but other researchers including Meissner in Germany and Round in England were concurrently researching positive feedback. Armstrong actually made his discovery in 1912, whilst still an undergraduate at Columbia University.

As well as rectifying, the grid leak detector operates as a reasonably linear amplifier, to both RF and AF signals, and consequently both are present in amplified form at the anode. It

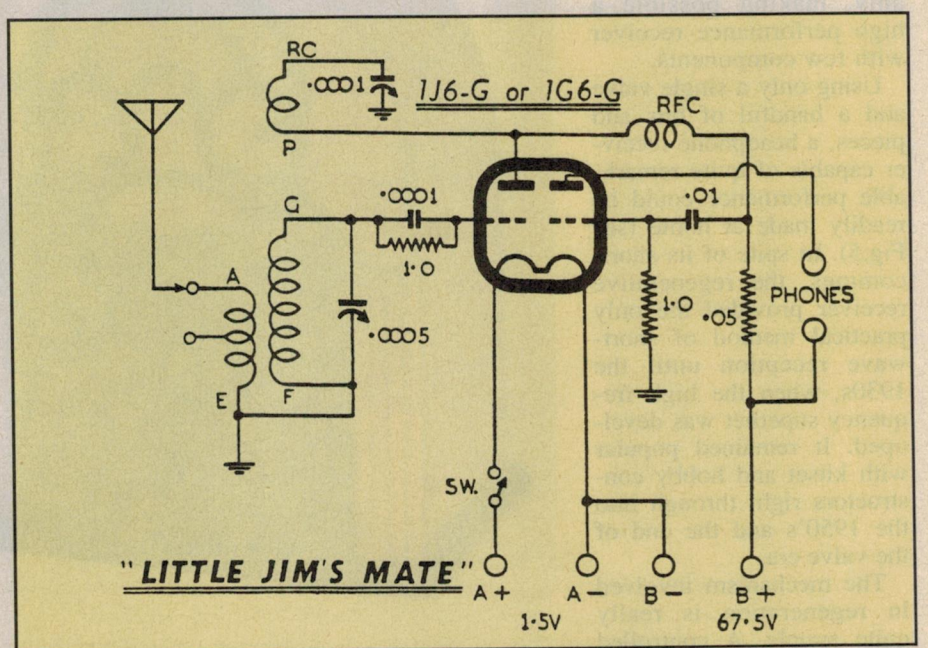


Fig.5: Sensitive and simple to build, the regenerative grid leak detector insured its popularity with experimenters long after its abandonment in commercial receivers. This typical circuit appeared in our ancestral Radio & Hobbies for January 1947.

was while Armstrong was investigating the RF component at the anode of a triode detector that he connected a tuning capacitor and inductance in series with the headphones, creating in effect a tuned grid-tuned plate oscillator.

The result was dramatic, to say the least. Suddenly his one valve receiver was displaying incredible sensitivity, receiving signals at previously unheard-of distances. Furthermore pure continuous wave (CW) signals from arc transmitters did not need a heterodyne signal to make them audible.

He had discovered a revolutionary new method of reception.

Regeneration has to be the best method of getting something for nothing that radio has ever known, and there can hardly be an 'old timer' who has not explored this application. With regeneration, the sensitivity and selectivity of a grid leak detector can be improved most remarkably, making possible a high performance receiver with few components.

Using only a single valve and a handful of bits and pieces, a headphone receiver capable of quite remarkable performance could be readily made at home (see Fig.5). In spite of its shortcomings, the regenerative receiver provided the only practical method of short-wave reception until the 1930s, when the high frequency superhet was developed. It remained popular with kitset and hobby constructors right through into the 1950's and the end of the valve era.

The mechanism involved in regeneration is really quite simple. A controlled amount of RF energy from the anode is fed back to the grid, in phase. This is positive feedback, resulting in a build up of energy and in the process, raising the effective 'Q' or efficiency of the tuned circuit to a remarkable degree. If the feedback is carefully controlled to the verge of oscillation, sensitivity and tuning sharpness are increased enormously.

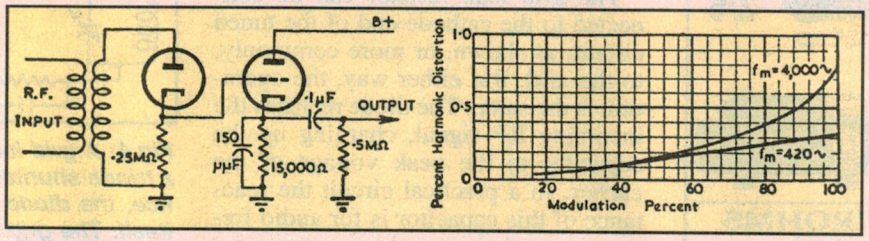


Fig.6: This high performance detector arrived too late to find acceptance in commercial receivers. A limitation is its inability to provide automatic gain control voltage. A 12AU7/ECC82 double triode with one half connected as a diode works well.

Higher quality audio

With the arrival in the late 1920s of mains-powered receivers and moving coil loudspeakers, with their potential for better quality reproduction, the shortcomings of the grid leak detector for use in domestic receivers, especially its distortion, became increasingly apparent.

Mains operation exacerbated another problem — that of noise. The inability of a grid leak detector to provide more than a volt or two of audio meant that two stages of transformer-coupled amplification were necessary. This in turn resulted in a very high audio gain from the grid of the detector. In fact the total audio gain from the detector grid to the anode of the output stage could easily be in excess of 2000, making the elimination of hum and microphony difficult.

The answer was the biased or plate detector, sometimes also called the anode-bend detector, in which the valve is biased to the point where, with no signal, the anode current is virtually nil. This bias can be from a fixed source, but in the case of indirectly heated valves, was invariably derived from a cathode resistor.

When an alternating voltage, such as an RF signal is applied to the grid, the negative-going excursions have little effect on the already cut off anode current. Positive excursions however, oppose the bias and permit anode current to flow. The stronger the signal, the greater the reduction in grid bias and consequently, the larger the anode current flow. If the signal applied to the grid is modulated, the positive going components only will be amplified, and the anode current will vary with the modulation, producing an amplified signal at the anode.

It will be apparent that in the case of a weak RF signal, the anode current will be very small, and the valve will be unable to provide efficient amplification;

Curved top 'Cathedral' receivers from the period 1931 - 33 are very popular with collectors. Many, like this 1931 'Zenette' LH, used a biased detector.

efficient amplification; whereas an exceptionally strong signal will drive the anode current into saturation, creating serious distortion. In between these points however, the triode biased detector is efficient, with a degree of distortion that was acceptable by the standards of the day.

General practice was to control the gain prior to detection, so that the operating levels were taken care of, and an advantage was the high input resistance which minimised loading on the detector tuned circuit.

Soon after the adoption of the biased detector, the screen grid '24A and later, pentodes such as the 57 became available. A popular lineup for Australian made receivers was a 57 oscillator/mixer, a 58 IF stage and a 57 biased detector, driving a pentode output stage.

Unfortunately, there was no operating condition that produced low distortion and as a result, collectors today may spend fruitless time chasing nonexistent faults in these receivers, in an effort to produce better sound.

By the mid 1930s the rediscovered diode detector had taken over in all but the cheapest receivers. The low distortion reflex or *infinite impedance* detector was used by some enthusiasts, the name indicating that the input impedance was very high. In some instances, it was a standard biased detector but the cathode resistor was not bypassed for audio.

One version was really a cathode adaptation of the same detector but with the audio signal taken from the cathode. The load resistor was also the unbypassed bias resistor, producing 100% negative feedback and therefore no audio gain, but with very little distortion. A major limitation was that the receiver needed a separate AGC detector, but nevertheless at least one commercial receiver, the New Zealand Radio Corporation's luxury model 99 used the infinite impedance detector.

Finally, as shown in Fig.6, an excellent detector appeared in 1953 as the result of work by W.T. Selsted and B.H. Smith. This is a combination of a diode with excellent AC to DC ratios, directly coupled to a cathode follower. Overall distortion is less than 1.0% at 100% modulation. Again, the major shortcoming for a commercial application is a lack of an AGC voltage.

I know of no commercial domestic application, but the New Zealand Broadcasting Corporation used it most successfully in their home grown fixed tuned TRF monitor receivers. ❖

NOTES AND ERRATA

PC-Driven Audio Sweep Analyser (March 1996): On page 65, in the schematic for the analyser section of the circuit, the 47k resistor connecting from the rotor of trimpot RV4 to the non-inverting input of U2a is labelled incorrectly as R24. It should be shown as R28.

Cancer & E-M Fields (February 1996): On page 20, the author states that a handheld GSM cellular phone could be rated at 1W continuous, giving 100W peak if the duty cycle were 100:1. It has been pointed out that in Australia and various other countries, the maximum permitted peak power level for handheld cellular phones is 2W. The paragraph was therefore misleading in terms of the level of risk involved, and for this we apologise.

However please note that there may still be a risk in having a peak power of 2W radiating a few tens of millimetres from the user's brain.

Microwave HV diode tester (CDI, December 1995): The last sentence in the third paragraph should read 'Then reverse the probes across the diode'.

PC-Driven DSO Adaptor Mk2 (May/June, 1994): To improve the stability and calibration of the instrument, especially when making measurements with 'DC' input coupling, the following modification is suggested so that R35 (1k) is included in the negative feedback loop around U8a. Cut the PCB link between pins 1 and 2 of U8a, and use a short length of insulated hookup wire to connect pin 2 to the 'other end' of R35 — i.e., the end connecting to C25, R6, R14 etc. ❖

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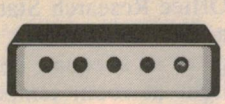

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April 1946

Progress of FM: The PMG is about to make a review of the Australian broadcasting set-up, with particular attention to coverage, the intention being to present a report concerning the use of FM stations at some future date. At the recent inquiry into broadcasting, the PMG representatives who gave evidence made very favourable recommendations to this end, and were obviously of the opinion that FM must find a place in our radio destinies.

New FM circuit: If a well known US radio manufacturer's claims are correct, FM receivers may soon be possible nearer to the size of our AM sets. The scheme hinges round a new detector which responds to FM but no AM signals. It renders unnecessary the discriminator and limiter stages now use, thus saving two valves. Seven or eight valves have been considered minimum for FM sets.

April 1971

Ship-shore telephone: The Australian Post Office and the Overseas Telecommunications Commission introduced a ship/shore radiotelephone service at Brisbane on December 30, 1970. The new services permit people on suitably equipped ships, pleasure craft, or other vessels within range of the Brisbane station to have direct telephone interconnection into the Australian network. The service is continuous and standard commercial rates apply to the calls.

Laser communications: Standard Telecommunications Laboratories Ltd in cooperation with the British Post Office Research Station has developed a tiny laser, about 0.5mm long, that gives an adequate continuous output of light at room temperatures. Called a double heterostructure gallium arsenide laser, the device is a step towards the realisation of fibre optic transmission lines capable of carrying hundreds of times more information than present coaxial systems.

The company states that fibre systems to be developed soon will carry as many as 100 television channels, and that such systems, using a bunch of fibres, are likely to be essential to realisation of video telephones on the scale of present audio telephone networks.

University radio: The University of Adelaide has been granted a licence to operate its own radio station. It will operate on 1630kHz, outside the normal broadcast band, with a radiated power of 300W. It is expected to be on the air later this year. Under the terms of its licence, the station must play no music and the programs must relate only to courses provided by the university for students. The plans were announced after an anonymous donor gave the university $100,000 to establish an educational broadcast system. ❖

EA CROSSWORD

ACROSS

1. Part of the communications network. (9)
6. Stored-value item, the --- card. (5)
9. Occurrence in the charging of car batteries. (7)
10. Type of runaway. (7)
11. The polygraph may detect these. (4)
12. Sunspot activity can generate an electrical ----. (5)
13. Check and revise information. (4)
16. Its flux is measured in lumens. (5)
17. Government charge. (5,3)
21. Problem-solving professional. (8)
22. Unit of work. (5)
25. React with a surface. (4)
27. Interval between events. (5)
28. Lustrous crystal. (4)
31. Property of mass. (7)
32. Material used for stylus. (7)
33. Made a mistake. (5)
34. Device with astronomical range. (9)

SOLUTION TO MARCH 1996

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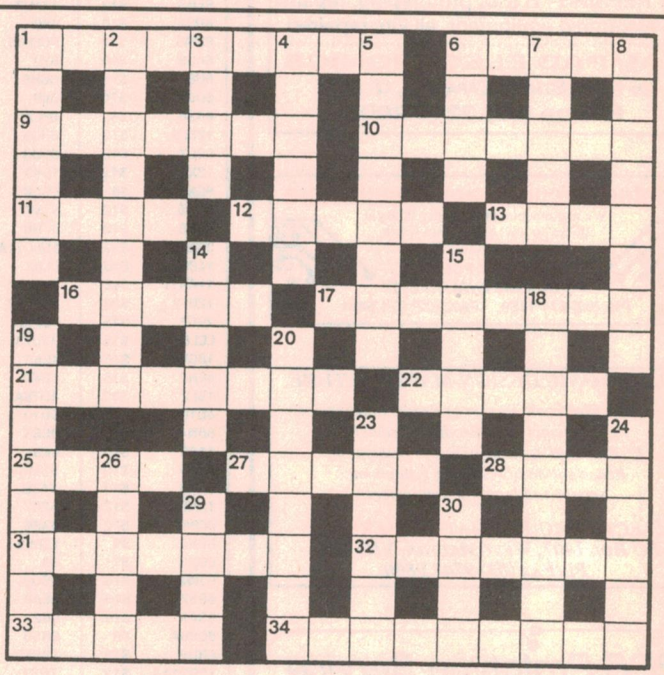
DOWN

1. Type of switch. (6)
2. Audiophiles love doing it. (9)
3. Famous demonstration by Faraday, the ice ---- experiment. (4)
4. Logical device. (2,4)
6. Search for. (4)
7. Set for intruder detection. (5)
8. Broadcast information system. (8)
14. Component in parallel. (5)
15. Gas used in high intensity lamp. (5)
18. Type of lens. (9)
19. Broadcast TV signals. (8)
20. TV program. (8)
23. Composer of Messiah oratorio. (6)
24. Rest for handset. (6)
26. Headless bolt. (4)
30. The Viking spacecraft landed here. (4)



Electronics Australia's

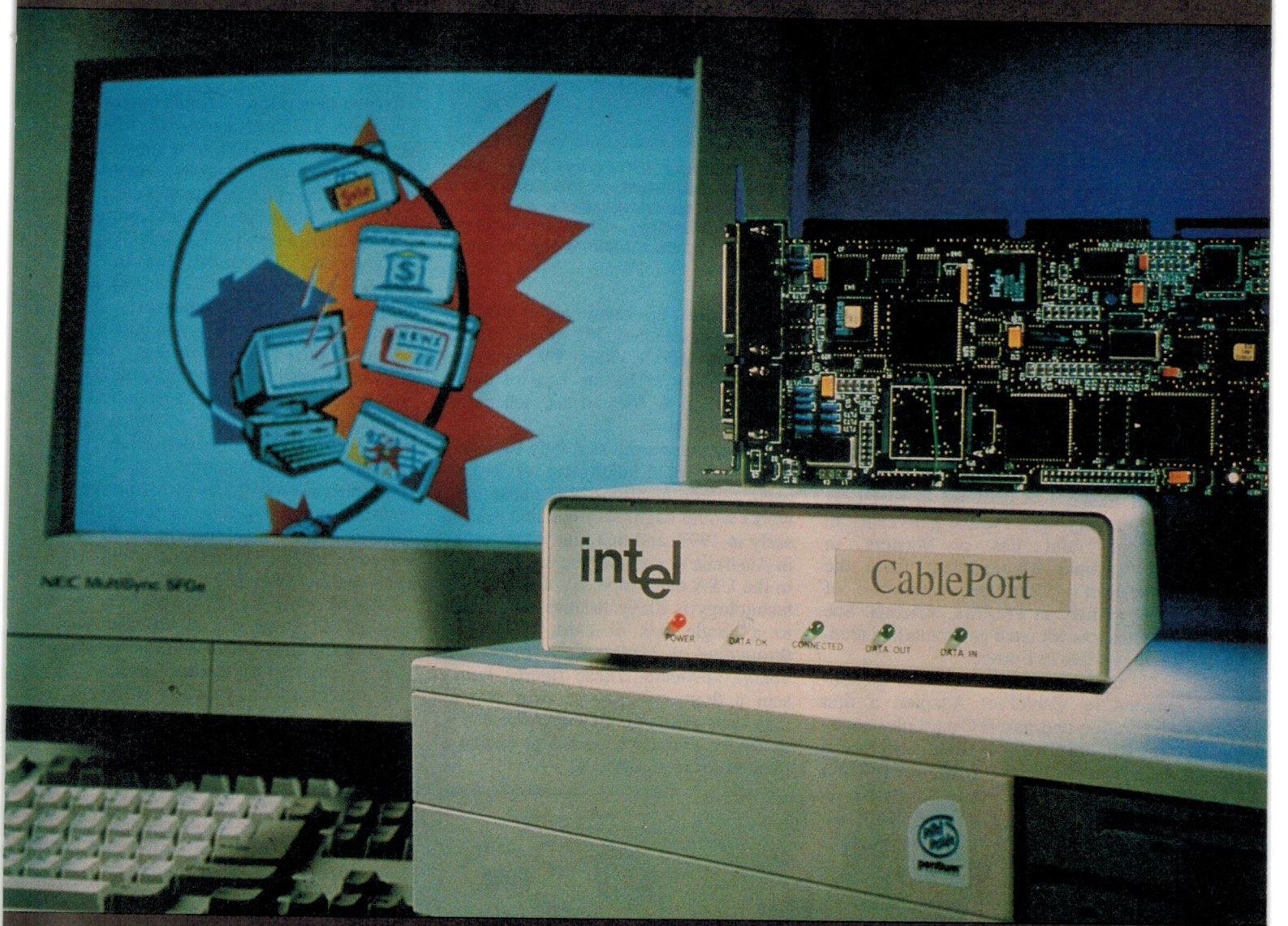
Professional Electronics

S◆U◆P◆P◆L◆E◆M◆E◆N◆T

KOREA'S SAMSUNG DEVELOPS PROTOTYPE ONE-GIGABIT SYNCHRONOUS DRAM CHIP

DR GILBERT AMELIO LEAVES NATIONAL SEMICONDUCTOR TO RUN APPLE COMPUTER...

REVIEWS OF AUSTRALIAN MADE DC/AC INVERTER, NEW H-P PROGRAMMABLE TRIPLE POWER SUPPLY, LOW COST 80C51 DEVELOPMENT SYSTEM



INTEL'S NEW 'CABLEPORT' MODEMS WILL ALLOW CABLE TV SUBSCRIBERS TO DOWNLOAD DATA AND FILES AT UP TO 27 MEGABITS/SECOND, AND UPLOAD AT 96 KILOBITS/SEC — FOR A COST VERY SIMILAR TO CONVENTIONAL 28.8 KILOBIT/SEC MODEMS! AUSTRALIAN TRIALS ARE PLANNED SHORTLY...

NEWS HIGHLIGHTS

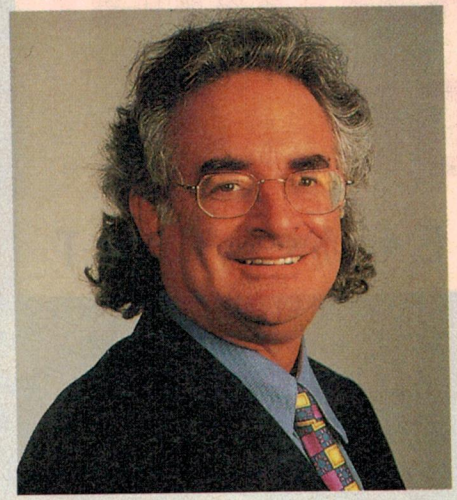
INTEL PREVIEWS ITS CABLE MODEMS

At a press conference in Sydney a few weeks ago, Intel Corporation gave a demonstration of its cable modem technology and also opened a local Communications Products Centre for the testing, configuration and deployment of broadband technology. At the conference it was announced that the new Centre will be working with telecommunications carriers, content providers and Internet access providers for the deployment of broadband technologies in this region, and that this will include local trials of cable modem technology.

The new centre is being managed by Ms Teri Lasley, who was recently account manager for the cable modem/broadband technology trial project conducted jointly by Intel, Viacom Cable and Hybrid Networks, Inc in Castro Valley, California. That project began in late 1994, and proved very successful; of the 250 domestic cable subscribers who participated, 170 elected to retain full broadband services when the trial ended and paid commercial operation began. Many said they now found the technology 'essential'.

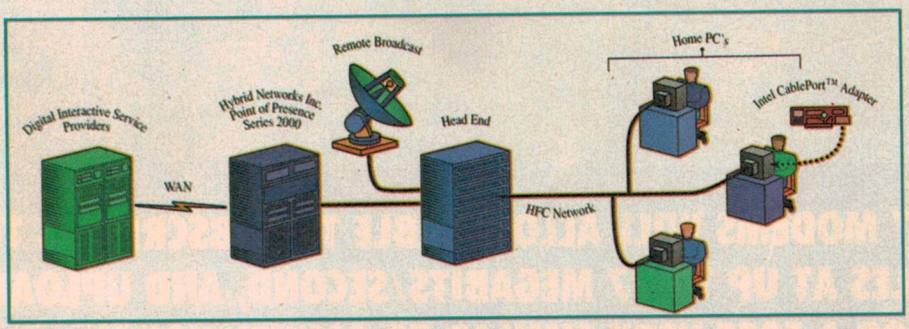
Ms Lasley is a graduate in Electrical Engineering from Purdue University in Indiana, and has a Masters in International Management from the American Graduate School of Management in Phoenix, Arizona. She has also coordinated cable modem technology trials in Europe.

At the press conference Intel demonstrated its CablePort Adapter, a first generation two-part (PC card plus external RF unit) cable modem offering a data throughput of 10Mb/s downstream and 19.2kb/s upstream when used to connect a standard PC to a hybrid fibre-coax (HFC) cable TV network. This is likely to be the type of cable modem used in local trials, scheduled for later this year.



Intel Corporate VP Avram Miller, who gave a presentation on the Company's broadband communications and cable modem technology — from Santa Clara in California, via a 128kb/s duplex audio visual link.

Intel spokespeople said they expected that commercial marketing of broadband communications via cable networks would begin very late this year or early in 1997, and that this would occur in Australia at virtually the same time as in the USA or Europe. By that time the technology is likely to have progressed to a single box or card, offering a throughput of 27Mb/s downstream and 96kb/s upstream. These figures represent a dramatic increase over current data rates available via either the PSTN or ISDN, and are expected to enable a plethora of new services.



An impressive highlight of the Sydney press conference was an interactive "live" two-way video/audio link to Intel's Santa Clara headquarters, from where Corporate VP Avram Miller gave a presentation on broadband communications and cable modem technology. Mr Miller also fielded questions from Australian journalists, together with Viacom Cable's VP of Technical Development Mr Doug Semon.

CHIP CHIEF TAKES OVER AT APPLE

To no one's surprise, Apple Computer has fired its chief executive officer, Michael Spindler. But in a move that caught just about everyone, especially chipmaker National Semiconductor, off guard, Dr Gilbert Amelio agreed to take over as chairman and CEO at Apple. A.C. (Mike) Markkula, one of the founders of Apple in 1977, was moved from chairman to vice chairman.

Amelio, who had been a member of Apple's board of directors since November 1994, abruptly resigned from National — where he has been credited for turning the once ailing chip maker around into a market leader, in several critical chip product markets.

Spindler was ousted by the company's board during emergency board meetings in New York. He had been under fire as the company's profit margins and market share have dropped.

"As an avid Apple user since the days of the Apple II, I am delighted to be joining the management team of Apple, a company with an outstanding reputation for superior technology and customer loyalty", Amelio said in a statement.

The appointment of Amelio indicates that merger talks with Sun Microsystems or any other potential merger partners are dead, according to Tim Bajarin, president of Creative Strategies. "My best guess is that Amelio's intention is to move Apple as aggressively as possible — he'll focus on dealing with the restructuring and staying independent."

Amelio epitomises Silicon Valley. He has 16 patents to his name, including one for a semiconductor device that is

INTEL RELEASES 166MHz PENTIUM

Intel Corporation has announced immediate availability of the highest performing new products in its mainstream Pentium processor line, the 150 and 166MHz Pentium processors. The new chips owe their performance to Intel's advanced 3.3 volt, 0.35 micron manufacturing process technology. Intel's high volume capability will make it possible for system vendors to offer a variety of attractively priced configuration immediately, including products in the retail market segment.

"With the introduction of the 150 and 166MHz Pentium processors, users who want to experience the full capabilities of Windows 95 and multimedia rich software will have the best Pentium processor performance available today at their fingertips," said G. Carl Everett, senior vice president, Desktop Products Group. "System vendors are starting this year with the greatest choices of high performance systems for users, and with ease of use increasingly built into hardware and software, we expect PCs to make further inroads as a consumer product'.

The 166MHz Pentium processor delivers 4.76-SPECint95 and 3.37SPECfp95 of performance, while the 150MHz Pentium processor delivers 4.27SPECint95 and 3.04SPECfp95. SPEC is a widely used processor benchmark. In 1000 unit quantities, the 150MHz Pentium processor is priced at US$547, while the 166MHz Pentium processor is priced at US$749.

used in consumer video cameras. After starting his career as a scientist in the 1960s at AT&T's Bell Laboratories in New Jersey, he moved to the valley in 1971 to join Fairchild, where he oversaw the company's microprocessor division.

In 1991, Amelio was recruited by National CEO Charles Sporck to take over the reins of National, which had lost money for eight of the previous 11 years and had bogged down in its acquisition of Fairchild Semiconductor in the late 1980s. When Amelio arrived, the situation was worse than he expected; "What the hell am I doing here?" he asked himself. The company was only a few weeks away from a bankruptcy filing.

Amelio came in and slashed costs. He closed factories, laid off thousands of employees and bailed out of several money-losing businesses. But for Amelio, there was a more fundamental problem at National. He believed the company lacked a clear vision of its future and needed to address employee morale.

Last year, National reported profits of US$264.2 million on sales of $2.4 billion.

DIPLOMA IN MOBILE COMMS

Australia's top players in the field of mobile communications have collaborated in the development of a leading edge education and training program — the Graduate Diploma in Mobile Communications Systems.

This is now being offered by the Australian Information Technology Engineering Centre (AITEC), using the resources of the Distance Education Centre of the University of South Australia and delivered nationally through Open Learning Australia (OLA). The program is formally awarded Graduate Diploma status by the University of SA.

The organisations involved in developing the course are Telecom Australia, Optus Communications, Vodafone, Ericsson, Nokia Communications, Philips Mobile Communications Systems, Hewlett-Packard and the Telecommunications Industry Training Advisory Board (TITAB). The course has been developed to meet the increased demand in the mobile communications industry for engineers and para-professionals involved in pager, trunked mobile radio, analog and digital mobile telephony.

It also services an additional demand for knowledge of new mobile systems for personal digital assistants and satellite mobile services.

Further information about OLA or the Graduate Diploma is available from Kathy Byrne, OLA Marketing Projects Officer, on (03) 9903 8906.

VALE DAVID BOTTO

It is with much sadness that we report the untimely death of David Botto, who contributed many articles to this magazine over the years and was author of our very popular book *A Basic Guide to Colour TV and VCRs*. A resident of Poole in the UK, he was also a regular contributor to the British journal *Television*.

Mr Botto had worked in the radio and TV industry for many years, and enjoyed sharing his knowledge and enthusiasm with others via his writing — which will be sorely missed. His death was due to cancer.

CONFERENCE ON SOUND RECORDING

The Australasian Sound Recordings Association (ASRA) will be holding its annual conference at the National Film and Sound Archive in Canberra, from 19-22 April 1996. Papers to be presented cover a wide range of interests, including:

Audio on the Internet, by Guy Petherbridge, with live demonstrations;
The Art of Reviewing CDs, by James McCarthy of the NFSA;
Finding the One-Liners, by oral historian Barbara Blackman;
More on Australian Film Music, by Di Napthali; and
Squashing the Dynamics — Necessity or Iniquity?, by Neville Thiele, dealing with dynamic compression in recording and broadcasting.

The final technical session of the conference will be on the morning of Monday April 22, and will explore Convergence between Digital Audio and Computers — Threat or Challenge to Sound Archives? Speakers will include Kevin Bradley, Manager of Sound Preservation and Technical Services at the National Library; Ian Gilmour, Manager New Technology at the NFSA; and Chris Middleton-Williams and Mike Steele of Sony Australia. This session of the conference will be held at the National Library of Australia. Further information about the conference may be obtained from Bruce Skilton at the National Film and Sound Archive, on (06) 209 3111.

NEWS HIGHLIGHTS

SAMSUNG'S 1G-BIT SYNCHRONOUS DRAM

Researchers at Korean semiconductor firm Samsung Electronics have produced a prototype one-gigabit synchronous DRAM memory chip — the first memory chip to achieve this milestone in data storage capacity. The researchers unveiled details of the chip at the recent Electronic Device Meeting in Washington.

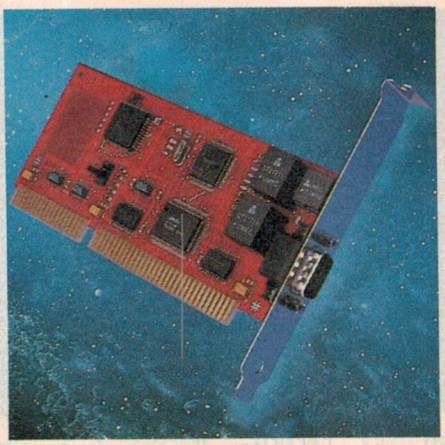
With an area of 500mm², the chip has a minimum feature size of 0.16mm and processes data in 31 nanoseconds. It uses special 32-bank synchronous architecture to achieve this speed and reduce power consumption. The storage capacity of a 1Gb chip corresponds roughly to 400 still pictures, 16 hours of sound recording or 15 minutes of digital video.

Samsung apparently expects to produce engineering samples of the chip next year, but full production may not begin until the year 2000.

LOW COST ISDN CARD FOR PCs

Just in time for end users to be able to take full advantage of Telstra's ISDN price cut, the Brisbane-based ISDN company Ticom has launched a new and inexpensive PC based ISDN solution for Windows and Windows 95 users.

Ticom's ISDN package consists of a high speed PC ISDN card, a software package for high speed file transfer, fax and terminal emulation as well as a com-



pletely ISDN enabled Internet package. The package is available through Ticom' distribution partners throughout Australia. It carries a retail price of 899.

The Ticom Bye-Bye Modem Pack consists of three components which fit together to form a complete ISDN solution. The first component, the AVM ISDN Controller A1, is a high performance 16-bit ISA/EISA ISDN Controller which provides the industry standard CAPI interface to make based rate (2 x 64kb/s) ISDN services available to ISDN applications. The support of the open CAPI standard for ISDN cards is an important feature for end users, because it ensures vendor independence and future expandability of the ISDN PC platform, e.g., for later integration of video and digital voice applications. The A1 Controller is Austel approved and can be operated directly on a Microlink or behind a digital PABX. It comes with an easy setup program for DOS and Windows, test utility and DOS utility desk.

For further information contact Ticom Pty Ltd., phone (07) 3367 0450 or fax (07) 3368 2923.

REVOLUTIONARY X-RAY INSTRUMENT

A three-year collaborative effort by NASA, industry and university researchers has resulted in the development of an instrument which can generate the world's most intense source of commercial X-rays.

Capable of generating beams that are more than 100 times the intensity of other conventional X-ray sources, the new instrument is expected to lead to improvements in biotechnology research and have a wide variety of applications in scientific research, medicine and industry.

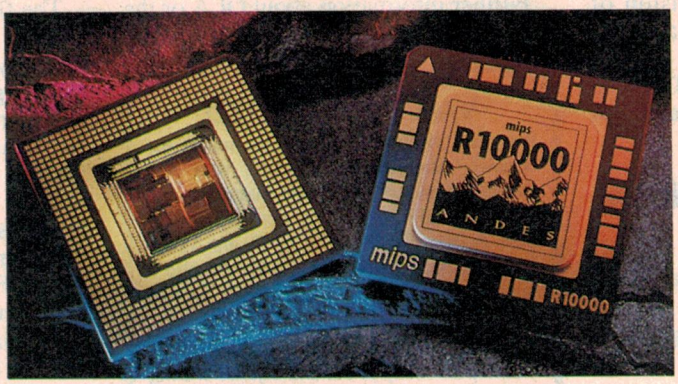
The revolutionary invention was developed by researchers at NASA's Marshall Space Flight Center, Huntsville AL; X-Ray Optical Systems, Inc., Albany, NY; and the Center for X-Ray Optics of the State University of New York at Albany. At the heart of the instrument is a new type of optics for X-rays called 'Capillary Optics'.

The X-rays are apparently controlled by reflecting them through tens of thousands of tiny curved channels or capillaries, similar to the way that light is directed through fibre optics.

The high intensity X-ray beams will

MIPS ANNOUNCES 200MHz PROCESSORS

Leading processor manufacturer MIPS Technologies, Inc., has launched two RISC (Reduced Instruction Set Computing) microprocessors which have set new performance records in real world applications. MIPS is a subsidiary of graphics workstation supplier Silicon Graphics.



The new 200MHz R10000 processor is claimed to have the highest integer and floating point performance of all microprocessors on the market. Preliminary performance ranges up to 9 SPECint95 and 19SPECfp95, based on future computer system designs and compilers that are currently being tested. The lower cost 200MHz R5000 is estimated to deliver 5.5 SPECint95 and 5.5 SPECfp95, in optimal system configurations.

Independent market research firm Dataquest recently reviewed the new processors. In a very positive report the company said though final performance ratings could only be given once systems were delivered, ... "The R10000 is likely to take the title of the worlds fastest microprocessor from Digital's Alpha".

The 200MHz R5000 and the R10000 MIPS RISC microprocessors are 64-bit, highly scalable chips for computers running UNIX and Windows NT operating systems.

MIPS studies show the R5000 architecture, with the MIPS IV instruction set and superscalar pipeline, can execute geometry processing routines 2.3 times faster than Intel's 200MHz Pentium Pro and more than seven times faster than the 133MHz Pentium processor.

AMTRON CONNECTOR WINS DESIGNMARK

Amtron Australia is the first Australian company in the data communication connector industry to achieve an Australian DesignMark. The DesignMark is operated by Australian Design Awards, a division of Standards Australia.

Huge growth in telecommunications has lead to an unprecedented demand for ID subminiature connectors. These connectors must perform to increasingly high standard and incorporate the vital need for RFI (Radio Frequency) shielding whilst accommodating the various numbers of pin configurations and cable entry points.

In its design of the RFI Shielded Backshells, Amtron has managed to meet these industry driven challenges and secure Telstra and other OEM users contracts. By adopting the versatile Amtron award, Telstra has been able to substantially reduce inventory and increase the ease of use for workers in the field.

Amtron's RFI Shielded Back Panels are entirely Australian designed and manufactured. The DesignMark independent panel of assessment confirmed that Amtron used an integrated design philosophy, painstaking R&D and paid attention to the highest quality standards of manufacture.

permit scientific and medical research to be performed in less time and with higher accuracy. The development could also permit the use of smaller, lower cost and safer X-ray sources.

SYDNEY'S OFFCOM WINS OPTUS CONTRACT

Sydney based communications specialist Offcom has won and installed a major Optus contract for communication equipment at the West Australian ground station at Lockridge, Perth. Won against tough overseas competition, the contract represents another victory for the government's Australian Content technology policy.

Offcom's fully Australian designed and manufactured Auxiliary Interface Units (AIU) will provide 60 simultaneous channels linking fax and data communications over the MobileSat satellite into the normal telephone network.

A duplicate of the company's existing network set up at the ground station in the Sydney suburb of Belrose, the 60 AIUs allow full fax and data capabilities over NEC mobile telephone voice channels.

They complement Offcom's innovative MT101 Modem which provides a complete communications package for satellite mobile telephone users and is fully compliant with Austel's stringent regulations.

With the MT-101 and an NEC satellite telephone, users anywhere in Australia can send and receive voice, data and fax messages. The Modem also allows both Global Positioning Systems (GPS) and Messaging Terminals to be attached to further enhance the capabilities of the telephone.

AUSTRALIAN LASER FOR KOREAN THEME PARK

A small Australian firm has won out over international competition to supply an outdoor laser and multimedia display in Korea's largest them park. Minister for Trade, Senator Bob McMullan, said that Sydney based Laservision, with the assistance of Austrade, won the $7 million contract ahead of two American firms.

"Laservision's laser display in the Samsung-owned Yong In Farmland theme Park in Seoul is planned to be the biggest of its kind in the world" Senator McMullan said. "Laservision's success is another example of Australia's ability to provide world class high technology solutions overseas especially in highly competitive Asian markets."

"It also shows that Australian suppliers of high technology equipment and services can compete head-to-head with the toughest international competition in key export markets.'

Senator McMullan said Laservision's contract demonstrates the effectiveness of Austrade services and guidance for small and medium companies seeking export markets.

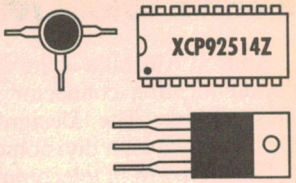
Laservision will supply an integrated multimedia control system to the Yong in Farmland them park, which will include 12 laser systems, film projection, light sound, waterworks and fireworks. The Laservision system will be unveiled at the park in April.

Korea is Australia's second largest export market, with annual exports now running at more than $6 billion. ❖

NEWS BRIEFS

- ***ATUG 96***, the 13th Australian Communications and Networking Exhibition will be held at the new Melbourne Exhibition Centre Southbank, 30 April - 2 May 1996. Enquiries on (03) 9429 6088.
- ***Analog Devices*** now has a site on the World Wide Web at http://www.analog.com. Data, technical and product information is available from the site.
- Expertise Events has been appointed to organise the ***SMPTE '97 Conference and Exhibition***, to be held at the Darling Harbour Convention and Exhibition Centre 25-28 August 1997. Enquiries on (02) 977 0888.
- The 13th International Electronics Industry, Testing Equipment and Instrument Exhibition for Asia ***EIE'96*** will be held from August 2-5, 1996 at the Hong Kong Convention and Exhibition Centre. Enquiries to Business and Industrial Trade Fairs on (852) 2865 2633.
- ***GEC Electronics*** has launched a World Wide Web site, which provides information on GEC and its services, and also specific product information. The Internet address is http://www.gec.com.au.
- ***Stanilite Electronics*** has won a Department of Defence contract to supply a Trunkswitch communications network to the Support Centre at Woomera Township in South Australia. The contract is valued at approximately $250,000. Stanilite's system will provide a modern communications network for the base, interfacing by radio to the site's PABX.
- US firm Intelligent Instrumentation (represented in Australia by ***Kenelec***) has set up a World Wide Web site to provide information about its range of hardware and software products for PC-based data acquisition, test and measurement, and control. An evaluation copy of the firm's Visual Designer software can also be downloaded from the site. The address is http://www.instrument.com. E-mail information is also available by calling info@instrument.com.

Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Single supply photodiode amp

Burr-Brown's new OPT101 combines a high performance photodiode, micropower transimpedance amplifier and a 1MΩ feedback resistor on a single monolithic IC. The device is ideal for a wide range of light sensing applications including smoke detectors, position and proximity sensors, medical and laboratory instrumentation.

The supply current is 120uA and single supply operation extends from 2.7V to 36V. It can also operate from dual supplies. An internal 7.5mV output pedestal voltage assures linear operation down to zero light, with a single supply. Other key specifications include a bandwidth of 14kHz and photodiode responsivity of 0.45A/W at 650nm.

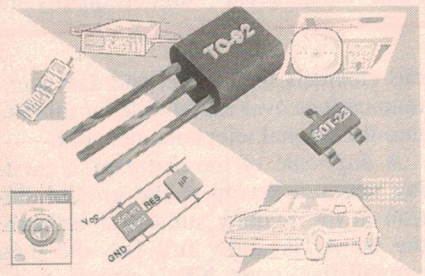
The integrated combination of photodiode and amplifier eliminates the problems commonly encountered with discrete designs, such as leakage current errors, noise pickup and gain peaking. The 2.29 x 2.29mm photodiode is operated in photoconductive mode for excellent linearity and low dark current.

The device is available in a clear plastic 8-pin DIP and 5-pin vertically mounted SIP. Both allow easy positioning of the light source.

For further information circle 251 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 0824.

Undervoltage sensing chip

The new V6340 low cost microprocessor reset IC from EM Microelectronic-Marin SA is in a tiny three pin SOT-23 package.



Its features include a typical power consumption of 38uA which stays stable during switching, and a wide temperature range of -40 to +125°C.

The device suits a wide range of applications, from automotive to white and brown goods.

For further information circle 254 on the reader service coupon or contact Dice Technologies, 13 - 15 Chandler Road, Boronia 3155; phone (03) 761 1031.

Dual-port SRAM memory module

Integrated Device Technology has introduced what it claims to be the densest true dual-port memory module in the industry. The 7MP1015, a 32K x 32 device, is 2.5mm square and is suitable for high bandwidth data buffering applications such as high performance switches in data communications, digital wireless base stations in telecommunications and industrial equipment and in high performance graphics.

With a 128KB buffer size, the 7MP1015 module enables higher bandwidth communications and provides a 32-bit data path operating at 40MHz on both ports, allowing data to be accessed up to 1.28 gigabits per second. This module replaces standard SRAM memory, offering greater density, space savings and an easy upgrade path. The 32K x 32 module also offers added flexibility with additional pins, allowing designers to upgrade to future 64K x 32 modules based on next generation density dual-port SRAMs.

The IDT7MP1015 is a high speed MOS true dual-port memory module which uses four IDT7007 dual-port SRAMs in thin quad flat packages (TQFP) on a single 128-lead dual in-line memory module (DIMM). With access

ADC for motor control

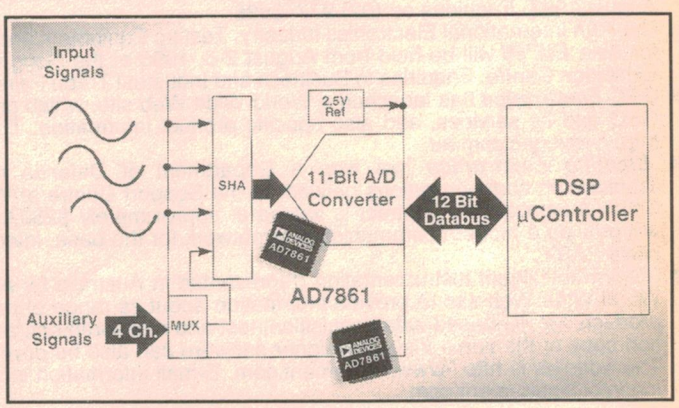
Analog Devices has introduced the AD7861, an 11-bit simultaneous sampling analog-to-digital converter (ADC) designed for use in motor control and three phase power systems.

The device provides four simultaneous sampling input channels, a four channel multiplexer for auxiliary inputs, a voltage reference, and double buffered output registers that can be read in any sequence, all in a 44 lead PLCC. The AD7861 will find use in machine tools, robotics, electric vehicles, fans, compressors, pumps, and plastic/rubber extrusion equipment.

Unlike the analog front end of most microcontrollers, the AD7861 is optimised for sampling analog motor variables, allowing simultaneous sampling of time critical current loop channels. The Vin1, Vin2, and Vin3 channels are simultaneously sampled to preserve the relative phase information of the input signals. The four auxiliary channels are multiplexed and are suitable for slower input signals, such as temperature and bus voltage of the diode rectifier output. Sample and hold acquisition time is 1.5us and analog-to-digital conversion time per channel is 3.2us.

The ADC is specified to operate with a +5 volt supply over a -40° to +85°C temperature range, and is packed in a 44-lead PLCC.

For further information circle 252 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

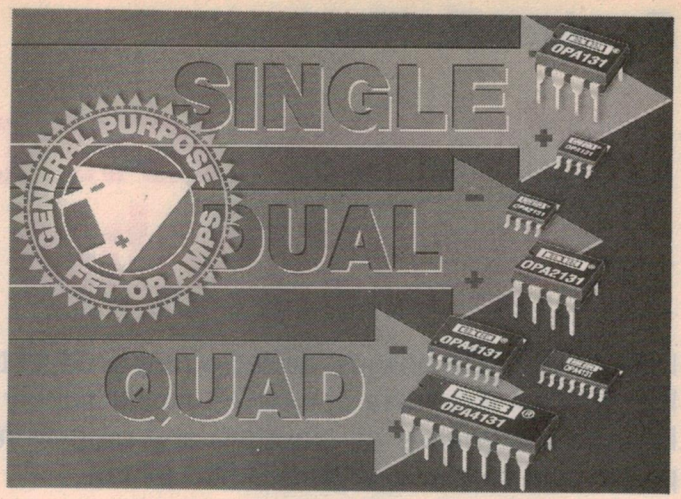


Precision FET input op-amps

Burr-Brown's new OPA131 family of operational amplifiers are intended for general purpose applications. Available in a single (OPA131), dual (OPA2131), and quad (OPA4131) versions, the new family supports a wide range of applications and package configurations.

Features include a 4MHz bandwidth and 10V/us slew rate, with a quiescent current of 1.5mA per amplifier. The devices operate on supply from +/-4.5 to +/-18V. Other key specifications include 750uV max offset voltage and 50pA max input bias current. Package options include an eight pin DIP and SO-8 surface mount in the single and dual versions. The quad version is available in a 14-pin DIP, SOL-16 and the smaller SO-14 surface mount package.

For further information circle 253 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone 1800 335 245.



times as fast as 25ns, this module provides two independent ports with separate control, address and I/O pins and allows for asynchronous read/write operations from either port.

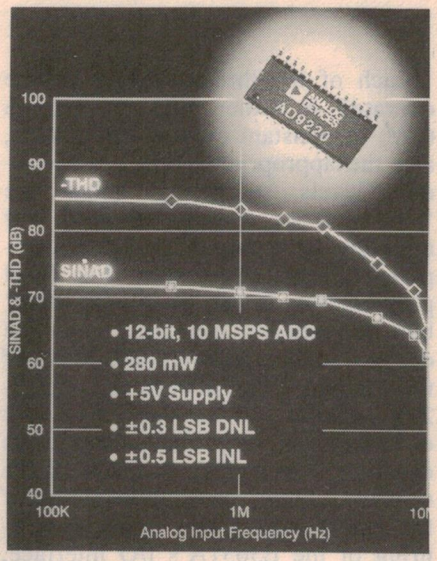
For further information circle 257 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

12-bit ADC offers 10MS/s

Analog Devices has introduced the AD9220, a 12-bit, 10MSPS monolithic analog-to-digital converter (ADC). It is the first in a new series of all CMOS, low cost, high speed, high resolution converters. The new ADC operates from a single +5V power supply, and consumes 280mW (typical) while converting at 10MSPS. It is designed for applications in the communications, imaging, and medical markets.

The ADC contains an on-chip, sample-and-hold amplifier (SHA) and voltage reference. The SHA can be configured for either single ended or differential inputs, and is equally suited for multiplexed systems that switch negative to positive full scale voltage levels in successive channels, and for sampling single channel inputs at frequencies up to and beyond the Nyquist rate (2x the signal's frequency). The programmable voltage reference can be set to 1V or 2.5V, and an external reference can also be chosen to suit the DC accuracy and temperature drift requirements of an application.

Additional features include a single clock input used to control all internal conversion cycles, and an out-of-range signal to indicate an overflow condition which can be used with the most significant bit to determine low or high overflow.



For further information circle 260 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

75MHz op-amp runs on 2.7V

A series of rail-to-rail input and output operational amplifiers which offer high speed at a low supply current has been introduced by National Semiconductor. The devices suit the portable instrumentation market and provide high signal fidelity because of the wide bandwidth. They operate from a broad supply range of 2.7V to 24V, easing overall design in mixed voltage applications.

The LM6132 (dual) and the LM6134 (quad) each operate at 10MHz while drawing about 360uA/channel of supply current. The rail-to-rail input and output of these amplifiers increases overall performance by maximising signal-to-noise ratio and dynamic signal range. The LM6152 (dual) and the LM6154 (quad) offer rail-to-rail operation at a speed as high as 75MHz. With the same variable supply range of 2.7V to 24V, these amplifiers offer a high speed solution for low voltage applications. This combination of features makes the LM6152/4 ideal for high speed portable instrumentation and data converter signal conditioning applications.

The LM6132 comes in eight pin DIP and SOIC packaging, the LM6134 is offered in 14-pin DIP and SOIC packaging. The LM6152 is available in eight pin DIP and SOIC packaging, and the LM6154 in 14-pin DIP and SOIC packaging.

For further information circle 256 on the reader service coupon or contact National Semiconductor, business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999. ❖

Product Review:

HP's new low cost Programmable Supply

Hewlett-Packard has just added a new product to its range of 'affordable' bench instruments. The HP E3631A is a triple output DC power supply with a rating of 80W, fitted with both HP-IB and RS-232C interfaces as standard and programmable using the widely-used SCPI language. It's priced at a very competitive $1600 ex tax.

by JIM ROWE

Programmable power supplies are becoming more and more necessary, as part of the inevitable trend towards automated testing in both manufacturing and R&D environments. The trouble is that until very recently, fully programmable supplies have been quite expensive. Many smaller companies on a limited budget have therefore been unable to take advantage of the benefits they can provide.

Happily things have now started to change for the better, though, with the release of a 'new generation' of programmable supplies offering a surprising level of functionality and performance, at significantly lower prices. A good example is the new HP E3631A from Hewlett-Packard, a triple output DC supply which has a total power rating of 80W and is fitted with both HP-IB (GPIB) and RS-232C interfaces as standard.

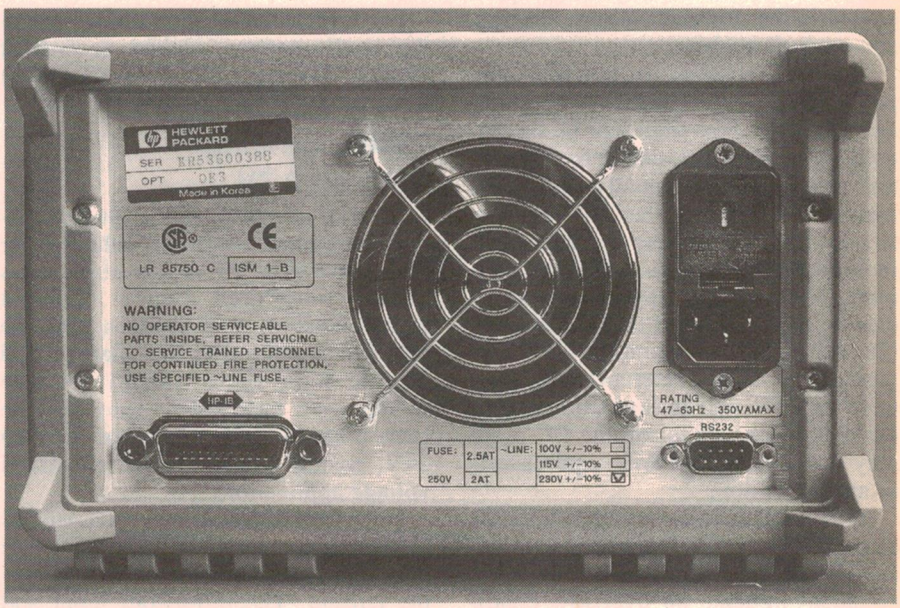
The E3631A provides three separate DC supplies, which can be varied independently: a 0 - +6V supply capable of delivering up to 5A, a 0 - +25V supply capable of delivering up to 1A, and a 0 - -25V supply also capable of 1A. The +25V and -25V supplies share a common terminal, and if desired they can be coupled together so that they track each other. This provides either a balanced dual polarity output, or a single 'voltage doubled' supply variable between 0V and 50V.

The +6V supply is optically isolated from the +25V and -25V supplies, and all three are optically isolated from both the chassis/frame and the HP-IB and RS-232C interfaces. In practice this means that the supplies can be 'floated' by up to 240V DC with respect to the chassis, or each other.

Each of the three supplies can be operated in either constant voltage (CV) or constant current (CC) mode, and the appropriate voltage and current levels set using either the 'local' front panel controls, or remotely by commands from a computer or other controller. For local programming a set of 10 'function' buttons allows selection of the desired supply, enabling/disabling of the tracking link between the +25V/-25V supplies, display and adjustment of either the voltage and current limits or actual voltage/current levels of the selected supply, enabling/disabling of the supply outputs as a whole, configuring of the E3631A's I/O interface, and storage/recall of up to three operating setups.

The actual adjustment of voltage and current levels is performed locally using a rotary control, in conjunction with a trio of further keys. One of these toggles between voltage and current, while the other two allow selection of the digit position 'operated on' by the rotary control. This allows fairly rapid manual adjustment, although for some purposes it isn't perhaps quite as convenient as a full numeric keypad. (Ideally, I guess, one would like *both*!)

The voltage and current levels for the selected supply are shown clearly on a bright vacuum fluorescent display, with primary digits about 10mm high.



Roughly in the centre of the supply's rear panel is the cooling fan grille, with the mains input connector to its right. Below the mains connector is the DB9 plug for the RS-232C interface, with the HP-IB connector at lower left.

Smaller readouts on the same display are used to indicate the selected supply, its operating mode (CV, CC or unreg), whether the limits or actual values are being displayed, whether tracking is enabled, whether the outputs are enabled, whether the E3631A is operating in 'Local' or 'Remote' programming mode and when a programming error has occurred.

The display resolution for the +6V supply is 1mV and 1mA, while for the +25V and -25V supplies it is 10mV and 1mA. However the specified programming accuracy of the +6V supply is (0.1% + 5mV) for voltage and (0.2% + 10mA) for current, while the equivalent figures for the +25V and -25V supplies are (0.05% + 20mV) and (0.15% + 4mA) respectively.

The rated line and load regulation for all three supplies is less than (0.01% + 2mV) for voltage and (0.01% + 250uA) for current, while the rated ripple and noise between 20Hz and 20MHz is less than 0.35mV RMS (2mV p-p). The equivalent ripple and noise current figures are less than 2mA RMS for the +6V supply and less than 500uA RMS for the +25V and -25V supplies.

Rated tracking accuracy for the two 25V supplies is (0.2% of output + 20mV). The transient response time for the output voltage of any supply to return to within 15mV of its set value following a change in output current from full to half load, or vice-versa, is rated at less than 50us.

As well as being remotely programmable, via either the HP-IB or RS-232C interfaces, the three supplies can also be 'read back' remotely as well — allowing the computer to monitor the *actual* voltage and current levels of each supply. The rated programming and readback resolutions are identical for each supply, and are given as 0.5mV/0.5mA for the +6V supply, and 1.5mV/0.1mA for the +25V and -25V supplies. The rated readback accuracy is the same as the programming accuracy: (0.1% + 5mV) and (0.2% + 10mA) for the +6V supply, and (0.05% + 20mV)/(0.15% + 4mA) for the 25V supplies.

Needless to say the remote computer can also enable/disable the supply outputs, enable/disable the tracking of the 25V supplies, toggle the E3631A between Local and Remote modes, change the voltage/current limits for each supply, and so on. All of this can be done via either the HP-IB or RS-232C interfaces, each of which can be configured (locally) to suit the remote computer/controller. For example the supply's HP-IB address can be set to any value between 0 and 30, while the RS-232C port can be set to any of six data rates between 300b/s and 9600b/s, and for either 8/none, 7/even or 7/odd formats for data bits/parity.

Whichever interface is used, the remote programming is performed using the widely used and easy to understand SCPI (Standard Commands for Programmable Instruments) language. SCPI commands are simply text strings, such as '**APPL P6V, 3.05, 1.0**' to set the output of the 6V supply to 3.05V, with a current limit of 1.0A. Similarly '**OUTP ON**' and '**OUTP OFF**' are the commands to turn the E3631A outputs on and off, respectively.

Because they are basically just text strings, it's fairly easy to send SCPI commands to the supply. Even a simple BASIC program can be used, for simple applications.

At the rear of the E3631A are found the IEC mains input connector, voltage selector and fuseholder, along with a standard IEEE-488 connector for the HP-IB interface and a DB-9 connector (male) for the RS-232C interface. There's also a grille for the supply's cooling fan.

Incidentally although the E3631A contains three separate microprocessors and a lot of digital circuitry for control, monitoring and interfacing, the actual power supplies themselves are of the conventional 'linear' type. As a result, the instrument meets a raft of international requirements regarding both safety and EMC compatibility — including IEC 1010-1(1990)/EN 61010-1(1993), CSA C22.2 No.1010.1-92, UL 1244, EN 55011(1991) Group 1, Class B/CISPR 11(1990) and EN 50082-1(1992)/IEC 801-3(1984).

Being microprocessor controlled, the E3631A can and does perform a sequence of self-testing diagnostics every time it's turned on. It's also calibrated digitally in 'closed case' fashion, via internal firmware and a lookup table, rather than via the traditional manual tweaking of preset pots. In fact there *are* no internal adjustments, as calibration is fully electronic; the various calibration factors are stored in non-volatile memory.

Full details of the calibration procedure are given in the E3631A's Service Guide, one of two manuals supplied with it. Also in the Service Guide is a description of the supply's circuit operation, a system block diagram and a full set of schematics, a complete parts list and a troubleshooting guide.

The companion User's Guide covers general power supply operation, front panel and remote programming, error messages and specifications. It also gives a selection of sample remote programming applications, to guide you in developing your own.

The E3631A also comes with a certificate of calibration, a power cord and a standard three-year limited warranty.

Trying one out

Thanks to Hewlett-Packard Australia, we were able to try out one of the first E3631A supplies to reach Australia, and put it through its paces.

It's a compact but solidly-built supply, with the case measuring 348 x 213 x 133mm overall and weighing 8.2kg.

HP's new low cost Programmable Supply

As supplied in free standing form, it's fitted with sturdy rubber buffers around the front and rear edges, to provide a measure of protection against accidental knocks. These can be removed easily if the supply is to be mounted in an instrument rack.

We found the E3631A quite easy to use. The fluorescent display is clear and bright, and in Local mode it's quite easy to set up any of the supplies using the front panel keys and rotary control. At times one might prefer the ability to key in a new voltage or current level directly, using a keypad, but on the whole the rotary control and 'cursor keys' system works well.

In any case, you effectively gain the ability to key in new parameter values directly when you control the E3631A from a PC, in Remote mode.

We tried this out, in fact, and found that it was very easy to control the supplies from the PC keyboard — even using a hastily-written BASIC program. We used the E3631A's RS-232C interface, hooked up to the PC via a 'null modem' cable, and after configuring the E3631A interface correctly, everything worked exactly as expected. Thanks to the SCPI language used, remote programming is really quite straightforward and intuitive.

We checked out most of the main aspects of E3631A performance, including programming and readback accuracy, load regulation, ripple and noise output, and tracking of the two 25V supplies. In each case we weren't all that surprised to find that the E3631A comfortably met its spec — after all, this *is* an H-P product!

Probably the only real criticism of the E3631A we can make is concerning its output Off/On function. The enabling and disabling of the supply outputs is not done via relays, but via electronic control of the supplies. As a result, when the outputs are 'Off' and nominally not electrically active, they can in fact still source or sink a small amount of energy.

According to the E3631A manual, in the Off state 'less than 0.6V of opposite polarity with no load, and less than 60mA of opposite direction current with a short circuit may appear at the outputs'. We were certainly able to measure significant 'reverse polarity' outputs from each supply in the Off state, and although they were inside the 0.6V/60mA figures quoted, we are still inclined to believe that they're a potential source of trouble in some applications.

To be honest, we'd far prefer the outputs to become completely and reliably inactive in the disabled state.

Apart from this aspect, though, we found the E3631A Programmable Supply an excellent performer. It should certainly meet the needs of many people for a programmable triple output DC supply, and the quoted price of $1600 ex tax should bring it comfortably inside many limited budgets.

You'll just need to remember that when the outputs are nominally 'Off', they aren't necessarily 'dead'...

Further information on the H-P E3631A is available by calling Hewlett-Packard's Customer Information Centre on 131347 extension 2902. This number is available from anywhere in Australia, for the cost of a local call. Our thanks to H-P for making the sample supply available to us for review. ❖

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12 ISSUES

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EL/105 3,4,5/96

Product review:

AUSTRALIAN MADE 120W DC-AC INVERTER

Designed and manufactured by Vass Electronics in Dandenong, Victoria, this compact 12V DC to 240V AC inverter has a short-term power capability of 400W, uses high-frequency switchmode conversion techniques and is fully protected against overload conditions.

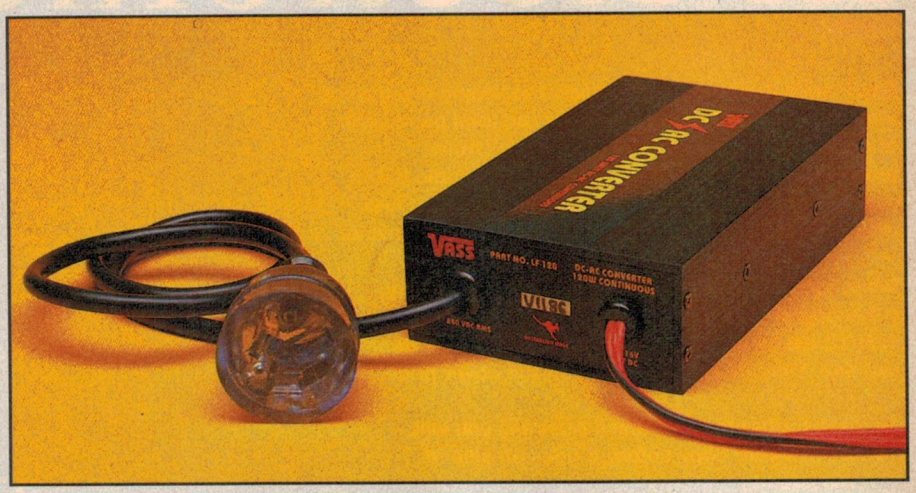
by ROB EVANS

Many readers are no doubt aware of the quiet revolution that's been under way in DC-AC inverter design over the last couple of years, where through the use of the same switchmode techniques employed in computer power supplies, the latest breed of inverters are both very efficient *and* extremely small in size when compared with their predecessors. As is the case with switchmode computer supplies however, it's fairly clear that *Australian made* examples of these hi-tech inverters are very thin on the ground; the majority of those currently on the market are of Asian origin.

It was with considerable interest then, that we took the opportunity to check out Vass Electronics' locally produced 120W inverter — a compact high frequency switchmode design, which must inevitably compete head-to-head with those already on the market.

The fact that Vass Electronics has been able to produce what appears to be a very competitive product right here in Australia may well be due to the versatile and diverse nature of the company itself, which according to their supplied literature has specialist capabilities ranging from hardware and software design right though to PCB insertion and wave soldering facilities. From this it would seem that Vass has full control over all aspects of its inverter production, and has used these resources to full advantage.

As you can see from the photo, the LF120 is housed in a plain rectangular case with both the DC input and AC outlet leads passing through what is effectively the rear panel. The 240V AC output cable is terminated in a mains-rated three pin socket as you would expect, while the 12V DC input lead connects to a standard automotive cigarette lighter plug so the unit can be quickly connected to a vehicle's 12V system.



Vass also has an optional 12V adaptor lead terminated in crocodile clips by the way, which allows you to power the inverter directly from the battery terminals. This avoids the inherent voltage drop in a vehicle's wiring harness.

Other than the two cable exit points the LF120's case is free of external fittings. Vass have elected not to include a power on/off switch — so the 240V AC outlet is activated as soon as DC power is applied — and the DC input fuse is installed inside the cigarette lighter connector, rather than in a conventional fuse holder mounted on the case panel.

To keep you in touch with the inverter's operational state the LF120 offers three status indicators, which are in fact internally mounted LEDs that are visible though matching translucent windows in the unit's front panel.

Here, the 'POWER' LED simply shows that a DC source is present, 'UNDER VOLTAGE' alerts the user that the DC input voltage has dropped below about 10.5V, and 'OVER TEMP' warns that the case temperature has risen to around 55°C. In fact the latter two indicators are really alerting the user as to why the LF120 has shut down, as its 240V AC output is disabled when the input voltage is low (in order to preserve the 12V battery for starting purposes) and also when the unit is in danger of overheating.

Besides the usual range of electronic safeguards that we've come to expect from compact switchmode inverters — such as overload, short circuit and reverse polarity protection — the LF120 also offers full electrical isolation (to 3kV) between its DC input and AC output circuitry. This somewhat unique aspect of the Vass design is intended to increase the electrical safety when the inverter is powered from a vehicle in particular, since with this arrangement, dangerous potentials can't exist between the 240V AC output and the vehicle's chassis — which of course, is directly connected to the inverter's DC input circuit.

So despite its fairly basic appearance the LF120 is clearly quite a sophisticated little unit, and should be a quick and effective solution to moderate power needs in a mobile or 'field' environment. As you might expect then, we were more than pleased to hear that the unit is both designed and manufactured in this coun-

try, and that Vass Electronics itself is a wholly Australian owned company.

Bench tests

We put the LF120 through its paces into a variety of 240V AC loads, which ranged from banks of light globes to a diverse array of domestic appliances. DC power was provided by a high current supply set for a nominal output of 13V, and the inverter's AC output current and voltage were monitored with a true RMS reading meter — necessary due to the LF120's 'modified squarewave' (or 'stepped sinewave', if you like) output signal.

Our initial tests were performed without a 240V AC load connected, where we measured the unit's input idling current at a 280mA, the AC output frequency at 50.7Hz and the AC output voltage at 262V RMS. While the no-load input current and output frequency figures are quite respectable results and close to the manufacturer's specification, we felt that the nominal output voltage was uncomfortably high for what is intended as a 240V AC power source. This is around 9% high in fact, whereas the LF120's specifications state an output voltage of 240V AC +/-2%.

To take a more positive view however, we would assume that this fairly basic discrepancy from the unit's specifications is an isolated case, and could be quickly corrected under the 12-month warranty included with the LF120. As Vass had also supplied a fully assembled circuit board for us to inspect, it was clear that reducing the output voltage would be quite a straightforward job since the three main adjustment presets (under voltage, output voltage and output frequency) are accessed by simply removing the unit's front panel.

When it came to checking the LF120's output voltage regulation and overall efficiency, we found that its output fell from 262V RMS to 257V RMS while driving a 120W load (that is, at full power) and in the process, consumed 148W from the DC source. This corresponds to a output voltage regulation of 1.9% and an input-to-output efficiency of 81%, which are both within the manufacturers specifications, and again, quite respectable figures.

Other than that, further testing showed that the LF120 had a load regulation of about 3% and an efficiency of 80% when driving a 160W load (way beyond its 120W rating), and on the other end of the scale, figures of 0.8% and 84% with a modest 60W load. These results represent a fairly high level of performance from the LF120, and while it's not quite in the league as some we have tested in the past (with efficiency figures as high as 93%, for example), the unit can clearly deliver much higher power levels than its nominal rating and make quite effective use of the available battery charge.

One other test figure that attracted our attention was the input voltage at which the LF120 disabled its AC output; the 'under voltage shutdown' figure. On test this was determined as exactly 10V DC while the inverter was not powering a 240V load, and 10.5V DC under full load conditions.

While these figures are close to the published manufacturer's specifications (10.2V and 10.7V, respectively), we can't help but wonder just how much starting energy is left in a 12V automotive battery when its terminal voltage is down to just 10 volts...

On the other hand, the LF120's voltage shutdown point is quite similar to that of other switchmode inverters we've tested, so we can only assume that most manufacturers consider a figure of around 10 volts to be the most effective balance between inverter operating time and battery reserve.

To be quite frank however, *we* would be inclined to raise this value to somewhere closer to 11V in a mobile situation, where the battery is also used to start a vehicle's engine. Thanks to the accessible nature of the LF120's adjustment presets though, this type of 'fine tuning' would be a reasonably simple task.

Amongst the range of switchmode inverters on the market then, we feel that Vass Electronics' LF120 offers the performance and range of features that should make it a prime contender for most buyers. It performs well when powering both resistive loads and more demanding 'real world' devices (computers, amplifiers, modestly sized motors, etc.), offers an effective range of electronic protection features, and is compact plus easy to use.

The LF120's strong position amongst its competitors should also be reinforced by its recommended retail price of $199 — plus of course, the servicing advantages of a product that is locally designed and manufactured. And by the way, Vass also offer a more robust 250W unit with an 800W surge capacity (model LF250), which is similarly well priced at $299 (RRP).

For more information on the Vass LF range of inverters, Vass Electronics can be contacted at 12 Tharle Street, Dandenong, Victoria 3175; phone (03) 9794 5780, or fax (03) 9794 5495. ❖

Review of the low cost

CEIBO 80C51 MICRO DEVELOPMENT SYSTEM

With microcontrollers becoming a major factor in today's electronics industry, it is important to be familiar with the basics of microcontroller applications. To this end we thought we'd have a look at the low cost DS-750 Development System from CEIBO/Philips, available from Geoff Wood Electronics, which is designed to program and emulate the Philips 80C51 microcontroller family.

by GRAHAM CATTLEY

If you have been following the ongoing debate regarding the use of microcontrollers in *EA* projects, you might have wondered how to break into the seemingly esoteric field of microcontroller programming. The idea of using one chip to replace a whole host of discrete ICs and other logic circuitry may be very appealing, but most would find the task of getting down to brass tacks and actually *programming* one just a bit daunting.

The DS-750 Development Tools package from CEIBO is designed to make writing, testing and debugging programs for the Philips 80C51 series of microcontrollers simple and inexpensive. At $159, the DS-750 is perhaps the best value for money around — but before we launch into a description of the CEIBO system, a brief overview of microcontrollers might be in order.

Computer on a chip

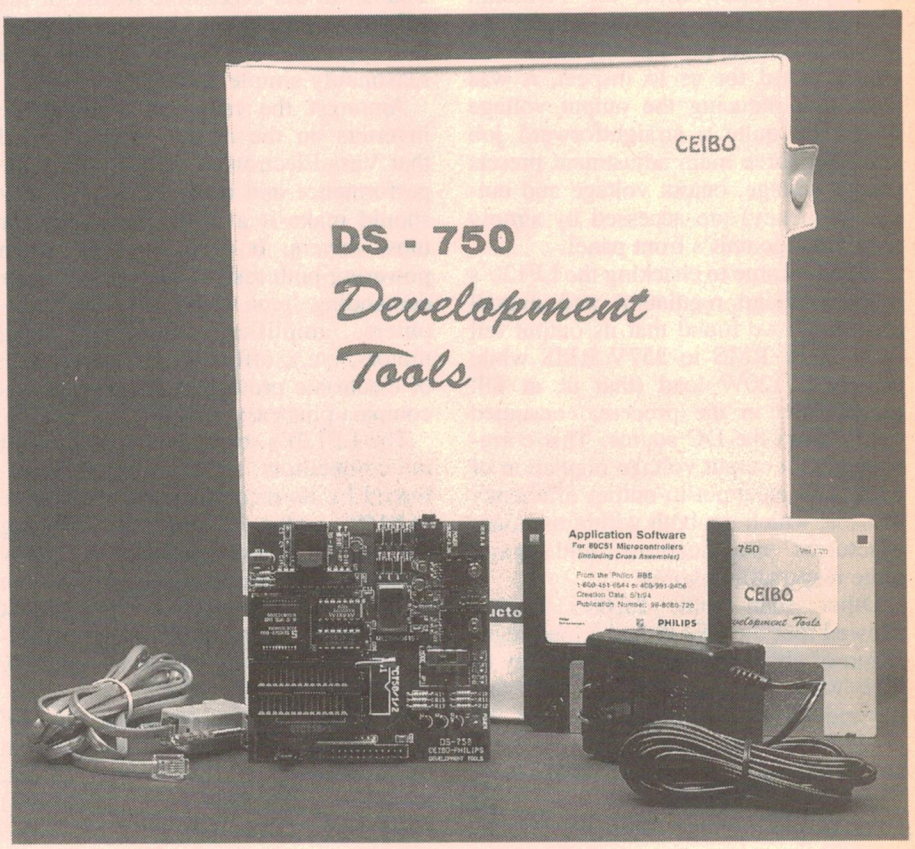
A microcontroller is essentially a whole computer on a single chip, incorporating CPU, RAM, ROM and I/O ports (usually both parallel and serial), with some even incorporating an A/D converter on chip as well. Micro-controllers have typically found application in process control situations in industry and in recent years have become more and more prevalent in automotive and domestic equipment — a new model washing machine will probably contain at least one, while a modern car may have up to four microcontrollers controlling various aspects of the car's operation.

Looking at the chip itself, you will usually find that CPU speeds can run up to 40MHz. When combined with a reduced instruction set, this can make for some pretty nippy little devices. Onboard RAM is usually quite small (usually in the 256 byte region), and while this may seem tiny in comparison with today's PCs, often surprisingly little RAM is needed as the program itself is held in ROM.

This is not to say, however, that you are limited to such a small amount of memory — it is usually a simple matter to incorporate external RAM into the application circuit design.

Microcontrollers are most suited to applications with complex or arbitrary logic which would otherwise take an inordinate number of discrete ICs to accomplish. A case in point is a data logger, where a microcontroller with an on-chip A/D converter may be used to take measurements and store them in an external RAM chip, and to display them on a liquid crystal display. Once the required number of readings are taken, the data is then sent via an RS-232C interface to a PC for analysis.

All of this can be achieved using only a couple of ICs, with the software programmed into the microcontroller taking the place of the myriad discrete coun-



ters, timers, interface and A/D converters that would otherwise be needed — not to mention the numerous logic gates needed to 'glue' the lot together.

The beauty of such a simple system is that as almost all aspects of the final circuit's operation are controlled through software programmed into the microcontroller (so that it then becomes 'firmware'). Any changes during the design stage are extremely easy to implement, as the program can be written in a high-level language such as C or even BASIC, making modifications to the circuit's operation simply a matter of changing a few lines of code.

The DS-750

You may have been hankering to get into microcontrollers, but have been a bit put off by the lack of practical information on the subject. If so, then you could do a lot worse than the CEIBO DS-750 Development Tools package from Philips. The package is quite impressive, including:

- An Emulator/programmer board, with an RS-232C interface and on-board firmware, enabling the simulation of the 80C51 family of microcontrollers;
- Two 1.44MB floppies containing the cross assembler, symbolic and source-level debugger (PLM, C, etc.), as well as several useful utilities;
- A 100-page user manual, detailing software operation and providing a number of tutorial experiments;
- Two massive databooks, totalling over 2000 pages, containing data on all 80C51 based microcontrollers, and example applications including circuits, source code listings, etc;
- One 87C750 and two 87C52 UV erasable microcontroller ICs, as well as a plugpack power supply and interfacing cables etc.

The three microcontrollers included are a good representative selection of the 80C51 range, capable of operation at clock speeds ranging between 5MHz and 40MHz, and sporting a 1K x 8-bit EPROM, 64 x 8-bit RAM, 19 I/O lines, a 16-bit counter/timer and an on-chip oscillator.

The emulation board measures 100mm square, and contains the power supply used both for running the emulator/microcontroller and for programming the microcontroller's own internal EPROM. As this board is designed to emulate an 80C51 microcontroller, a 24-pin header on the right hand side of the board allows the entire board to be connected in place of the microcontroller in the finished circuit, with the software running on your PC. This makes for extremely efficient testing and debugging, as the code can be changed in situ, without having to erase and reburn the chip every time a change needs to be made.

First impressions

After unpacking the box, I was a little overwhelmed by the sheer amount of information supplied on the 80C51 microcontroller family. Around two and a half kilos of databooks, manuals and application notes can appear a bit daunting when you first open the box!

Installing the software was straightforward enough, with the install program giving the option of installing for DOS, Windows, or both (the Windows version is simply the DOS version run within a window). The software, supplied on two disks, consists of an 80C51 assembler, a few utilities, and the C750D software used to actually program, emulate and debug the microcontroller.

This last program is the main focus of the kit, allowing you to directly enter assembly mnemonics, set breakpoints and debug both high level and assembly source code. Other features include the ability to trace program execution, monitor registers and I/O ports, and run a 'virtual' microcontroller, without the use of the emulator board.

The 100-page professionally bound User Guide is quite comprehensive and well laid out, covering every detail of the software, as well as a detailed description and circuit diagram of the emulator board. The last chapter of the book, titled 'Experiments', contains five in-depth tutorials covering a wide range of concepts, such as data transfer, I/O operations, arithmetic, logic, etc.

Unfortunately, the step by step instructions provided to get the C750D program running and to load in a small assembly program did not exactly mesh with the actual operation of the software. However, after a couple of abortive attempts, thinking that I was doing something wrong, I was able to configure the software so that it matched the examples given in the manual. This was not a major problem, but considering that the manual went into such detail about which keys to press, and when, it's a shame that the instructions weren't a little more accurate.

A small 14-page Philips booklet entitled *The DS750 Companion* that was included in the package proved to be an invaluable aid in getting the whole system up and running. This booklet not only explained how to assemble programs, but also gives helpful and accurate information on loading, modifying and running them; information that was either missing or inaccurate in the user manual.

One point worth mentioning about the DS750 package is that the manual assumes a fair amount of prior experience in microcontroller programming. It goes into great detail about how to perform specific tasks, but gives no explanation as to why, or what would be achieved by doing them. For example, to add a 'watch', the manual tells you to press Alt-V, type 'P1', and to then press Enter — but does not explain what watches are, or how they used in debugging programs.

In fact, nowhere in the literature supplied is there any information on actually *writing* programs — the experiments do help a bit, but it is apparent that in order to use this package effectively, you will need to have a fair understanding of 80C51 assembly language programming, or at least a good book on the subject.

Hardware emulation

The whole point of a development system such as the DS-750 is the ability to use your computer to emulate the microcontroller in your application circuit. The DS-750 board connects to your PC via an RS-232C interface, and has a 24-pin emulation header that can be plugged into the application circuit being developed, allowing the combination of the emulator board and the software running on your PC to emulate the microcontroller in the circuit. This allows the finished code to be refined and tested, without having to erase and re-program the microcontroller every time a change is made.

This is accomplished in the DS-750 by programming one of the supplied 87C752 microcontrollers with a small monitor program that interfaces the software emulator in the PC with the emulation port. Although the user manual was very specific about this procedure, the examples given didn't work. This was rather unfortunate, as being unable to use this aspect of the system left rather a big hole in this review.

Although the explicit instructions were followed to the letter, twice, and with separate microcontrollers, the demonstration program halted, reporting several strange system errors which bore little relation to their brief explanations in the appendix. It looked as though the monitor program was being successfully transferred into the micro, but it was in some way incompatible with the small (two instruction) program that

Continued on page 123

NEW PRODUCTS

Function generators have touch screen

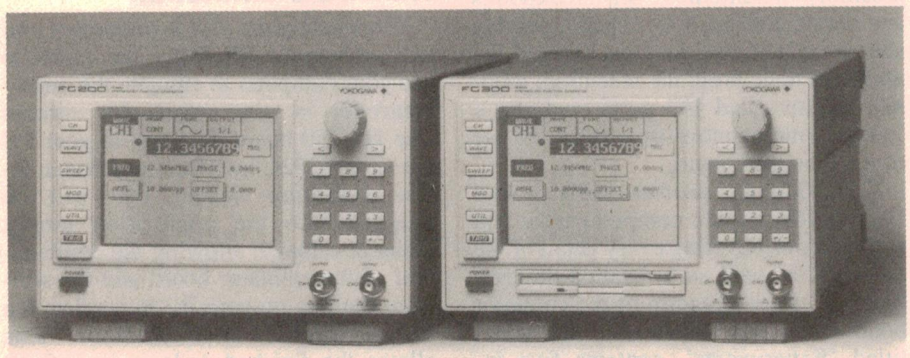
The FG200/FG300 series function generators from Yokogawa offer two channels in a compact, lightweight package, and feature sweep and modulation capabilities. The FG300 series also has arbitrary sweep and simple arbitrary waveform definition capabilities. The new generators provide sine and square outputs up to +/-10V over a frequency range of 1uHz to 15MHz, and triangle, pulse and arbitrary (FG300) outputs from 1uHz to 200kHz. Frequency resolution is 1uHz or a maximum of nine digits.

Operation of the generators has been simplified by virtue of the large LCD and touch screen, with a great deal of information presented on each display screen.

The setup and display of arbitrary sweep patterns and simple arbitrary waveforms is defined by entering points within the scaled ranges on the X and Y axes, and can be generated using linear, step or spline interpolations between the points. Alternatively, the data can be loaded in ASCII format via the internal floppy disk drive.

Sweeps can be made in frequency, phase, amplitude, offset voltage or duty cycle, in linear, log, linear step, log step or arbitrary sweep patterns. The sweep parameters can be controlled by an external analog or digital signal.

For further information circle 235 on the reader service coupon or contact Yokogawa Australia, 25-27 Paul Street North, North Ryde 2113; phone (02) 888 1844.



PCM channel analyser

In an evolving product line to support the installation, line-up, maintenance, troubleshooting and recommissioning of digital switches, Wandel & Goltermann has announced the PCM-40 PCM channel analyser.

It is capable of all the measurements described in ITU-T Rec. G712 and Q.552/553.

The analyser runs under DOS and offers data acquisition with user definable automatic test sequences and tolerance masks. 'Half channel' measurements between analog and digital 2Mb/s PCM interfaces (ITU-T G.703) are simplified and made reproducible with the aid of precision Fourier analysis.

The test box weighs under 4kg and is controlled by an IBM compatible notebook computer. It allows on-site verification of the function and quality of

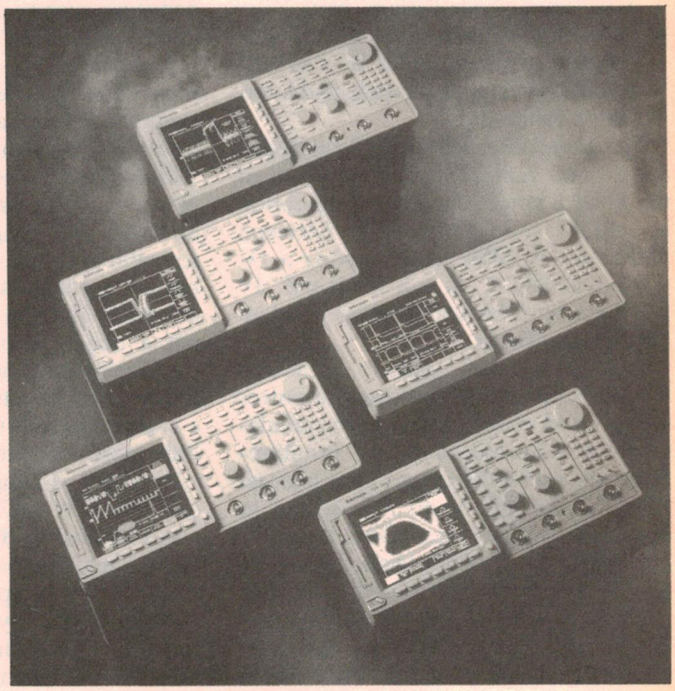
DSO family has 5GHz bandwidth

Tektronix has announced its new family of lower priced InstaVu acquisition oscilloscopes, the TDS700A series and TDS500B series of digital storage oscilloscopes (DSOs). Tektronix' proprietary InstaVu signal acquisition technology can capture up to 400,000 waveforms per second.

The TDS700A series includes the TDS784A, TDS744A and TDS724A. It features colour displays, bandwidths up to 1GHz and sample rates up to 4GS/s. The TDS500B series includes the four channel TDS540B and two channel TDS520B. Both scopes feature 500MHz bandwidth, up to 2GS/s sample rate, monochrome displays and up to 100,000 wfm/sec acquisition rate.

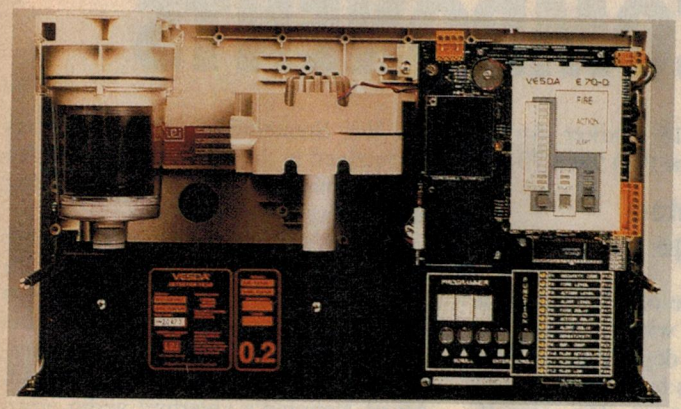
Tektronix' InstaVu acquisition technology is designed to quickly pinpoint and capture unpredictable, rapidly changing signals — infrequent glitches, metastable behaviour and time jitter that may never be detected by conventional analog or digital scopes. InstaVu technology combines high speed acquisition memory with high speed display rasterisation, to increase acquisition performance and ensure instantaneous live display of all signal changes.

For further information circle 233 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.



Scanner identifies specific fire source

The latest VESDA scanner, manufactured by IEI Australia is claimed to represent a major advancement in air sampling smoke detectors. Now marketed worldwide, the scanner not only detects fire at the smouldering stage, but identifies the specific fire source.



This is achieved through an innovative fail-safe valve mechanism that is built into the filter assembly. Under normal conditions, the valve effectively samples air from all protected areas simultaneously and identifies which of four air sampling pipes are detecting a potential fire situation. When a preprogrammed smoke level is reached, the scanner valve continues to rotate to monitor and report on the potential fire spread. The scanner is claimed to be able to function effectively in all types of environments ranging from high air flows such as computer rooms and clean rooms to manufacturing areas, as well as atria and warehouse facilities. It covers up to 2000sqm and is fully approved to meet all the relevant Australian Standards.

For further information circle 232 on the reader service coupon or phone IEI Australia Pty Ltd on (02) 554 4000.

digital switches with documentation on the hard disk, floppy or printer.

For further information circle 231 on the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

140W inverter

The new Powerpak 200 inverter from Optional Power weighs 6190g, and plugs into any automotive 12V cigarette lighter socket. It has a continuous output of 140 watts at 240V AC, and will power most laptops, small PCs, printers, fax machines and cellular phone chargers.

For tradespeople, the inverter allows workers to use small to medium sized power tools where mains power is unavailable, and it can be used for recharging cordless power tools as well. As back-up power, the Powerpak 200 can be used for lighting, television, and security systems.

It has a retail price of less than $200, an intermittent power rating of 200 watts, and a surge capacity of 400 watts. The inverter features an overload circuit breaker, and a low battery warning and shutdown device, plus red and green LED indicators and an audio buzzer.

For further information circle 237 on the reader service coupon or contact Optional Power, PO Box Q43, Sydney 2000; phone (02) 9979 9672.

'Smart' probes for DSO's

Tektronix has announced two new oscilloscope probes, the P5205 high voltage differential probe and the TCP202 AC/DC current probe. Both feature the intelligent TekProbe advanced scope interface, which eliminates the need for an external power supply or control interface.

Combined with the TDS500B and TDS700A digital storage oscilloscopes (DSOs), the new probes provide direct, correctly scaled measurement and display of differential voltage, current and instantaneous power in electronic circuits.

The resultant waveform, whether displayed on the scope, printed out or stored on a disk, is annotated with the correct numerical value and unit of measure, such as V (volts), A (amperes) or W (watts).

The P5202 high voltage differential probe is optimised for floating voltage measurements. This CAT II-rated probe has a 100MHz bandwidth and tip-to-tip differential voltage rating of 1300V and +/-1000 volt rating from tip to ground.

The probe's bandwidth limiting feature reduces noise, and an audible over-range indicator activates when the input signal exceeds the linear range setting.

The TCP202 AC/DC current probe measures current at frequencies from DC up to 50MHz. The probe will measure currents up to 15 amps to within 1% accuracy and a sensitivity of 10mA.

Current measurements are directly displayed on the screen with the correct annotation, eliminating the need for manual scale conversion.

For further information circle 236 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066. ❖

Special Feature:

THE LATEST IN COMPONENTS

MLC capacitors for Telecomms SMPS

AVX has announced a new series of surface mounted, high capacitance (up to 80uF) MLCs.

The series has been developed in response to the need for a low ESR/ESL capacitor characterised to handle high currents at switching frequencies above 200kHz, in comparatively small packages for telecomms SMPS filter applications.

Designated SM73/64/65, the ceramic capacitors are available in one and two chip assemblies. Dielectrics include COG (0.92uF max) for resonant capacitors, X7R (36uF max) and X5U (80uF max) for input/output filters. Voltage ranges are 50/100/200/500V DC.

For further information circle 201 on the reader service coupon or contact Veltex Australia, 18 Harker Street, Burwood 3125; phone (03) 9808 7511.

Electrical isolated TO-220 package

A TO-220 package offering complete electrical isolation without insulation washers and with no degradation of thermal performance has been developed by National Semiconductor. The new IC package is designed to house National's Overture audio power monolithic amplifiers, which are used to drive loudspeakers in televisions, mini-components and home theatre audio products.

National's new package design eliminates the need for placing mica washers or other insulating material between the package's lead frame and heat sink, a configuration routinely used for applications using split supply voltages (V+ and V-). Standard TO-220 dimensions are retained in the National design, with the exception of a thin overmoulding surrounding the heat tab.

National's isolated TO-220 package provides a thermal gradient equal to 1.6°C watt, which is nearly equivalent to a non-isolated package. With the elimination of the insulation washer, the thermal dissipation is virtually unchanged. All of National's Overture audio amps are available in this package including the LM1876TF, LM4700TF, LM2876-TF, LM3875/6TF and LM3886TF. These amplifiers are rated from 20 to 68 watts, continuous power.

For further information circle 202 on the reader service coupon or contact National Semiconductor Australia, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.

Driver for laser diodes

A new integrated laser diode driver from Analog Devices serves as a switched current source, simplifying the design of magneto-optical disk drives, and optically driven printers and copiers. The AD9660 can switch between separate read (bias) and write power levels at rates up to 200MHz, and contains integrated feedback loops to accurately control laser power.

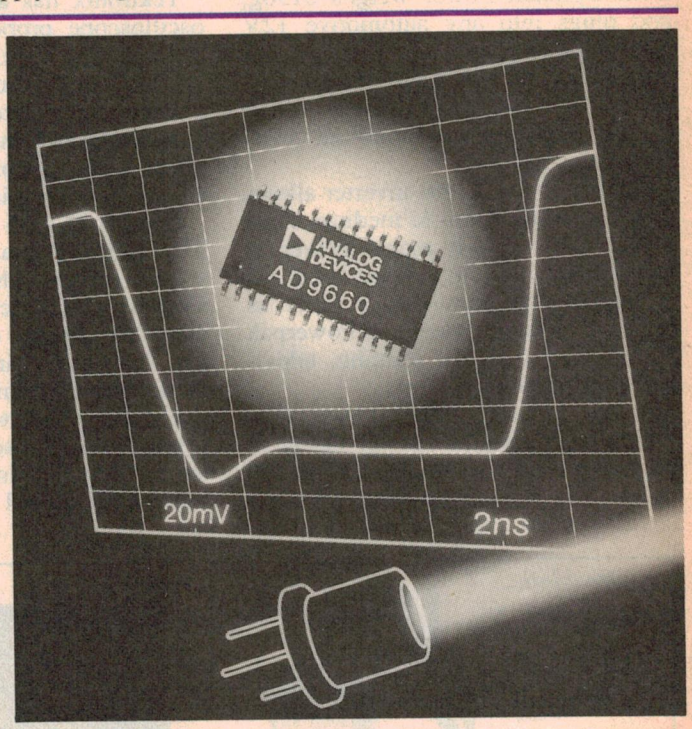
Dual analog feedback loops and output drivers produce independently calibrated read and write currents up to 90mA and 60mA respectively, at 3V. A third output provides up to 30mA of offset current (uncalibrated). Alternatively, the output can be set to follow an analog input voltage, achieving a bandwidth up to 25MHz.

The device has a sourcing current output, eliminating the need for an external drive transistor. The chip saves further board space by incorporating both track-and-hold and transimpedance amplifiers. The driver owes its high integration and fast current sourcing capability to Analog Devices' extra fast complementary bipolar (XFCB) process.

In addition, with typical output rise and fall times of 1.5 and 2.0ns, the AD9660 easily executes the image enhancing techniques, like pulse width modulation, that printers use to produce shades of grey. In magneto-optical disk drives, the high speed accommodates write pulse formats that help improve storage density.

An added feature of the device is its ability to continuously recalibrate. Supplied with feedback from the photodiode embedded in a laser diode's assembly, the driver can recalibrate the laser light output during each write pulse (requires greater than 25ns intervals). It is needed because laser diode outputs vary widely over both temperature and time. During high speed write operations, for example, heat build-up can change a laser's power as much as 10%.

Another feature of the AD9660 is an on-board disable circuit that turns off the output drivers, returning the laser light to a safe state. The chip operates from a single 5V supply and accepts TTL and CMOS level control inputs. It comes in a 28-pin plastic small outline (SOIC) package and operates over a commercial temperature range of 0 to +70°C. An IBM PC based evaluation board is also available.



For further information circle 210 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

Line driver has 130MHz bandwidth

The Comlinear CLC408 low power, high speed current feedback operational amplifier is designed to drive low impedance cables and highly capacitive loads while maintaining high signal fidelity. Operating on -5V power supplies, the CLC408 guarantees a continuous 96mA output current. It requires 15mW quiescent power, and has a 130MHz small signal bandwidth, 350V/ms slew rate and 4.6ns rise/fall times (2V step). The combination of low power/high speed performance makes the CLC408 suitable for battery powered personal communication/computing systems.

Target applications for the device include analog video line driving through coaxial cable and unshielded twisted pair (UTP). It can also be used for signal boosting applications such as driving single ended step-up transformers. The wide dynamic range makes the device an excellent high resolution A-to-D driver with its 20ns settling time (to 0.05%) and ultra-low -85/-76dBc harmonic distortion.

The CLC408 comes in an 8-pin package with standard op-amp pinout and is immediately available in plastic DIPs or SOICs (-40° to +85°C). For further information circle 205 on the reader service coupon or contact National Semiconductor Australia, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.

HV capacitors rated to 10kV

AVX has released its latest range of high voltage multilayer ceramic capacitors. Voltage ranges are from 1kV to 10kV, with capacitance values from 10pF to 2.7uF for each different voltage range in steps of 1kV.

The series consists of an X7R dielectric, where volumetric efficiency is paramount and a COG dielectric for applications where 'ultra' stability in terms of time, temperature, frequency and voltage variation is required. Surface mount styles are now available from CH91 packaging down to 1812/1412 chip sizes. The traditional J and L lead frame versions are also available. The temperature range is from -55°C to +125°C.

Typical applications for the COG capacitors are in tuned circuits, timing circuits and fast rise time circuits. The X7R capacitors are most commonly used in bypass and coupling circuits.

For further information circle 208 on the reader service coupon or contact Veltek Australia, 18 Harker Street, Burwood 3125; phone (03) 9808 7511.

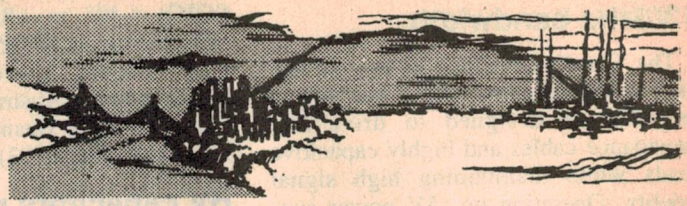
2mm pitch PCB connectors

The new PAK2 range from Robinson Nugent is a low profile 2mm hard metric interconnect system design that satisfies dense board-to-board packaging requirements. The system consists of 4-60 position vertical and 4-50 position right angle through hole headers, vertical 4-60 position SMT headers, vertical 4-60 position top and bottom entry through-hole sockets, 4-60 position right angle through-hole sockets and 4-60 position vertical SMT sockets.

The sockets offer an early mating point to ensure adequate wiping action and a reliable contact, compatibility with standard 2mm (0.020") square pins, and end-to-end stackability to maximise board density. Locator posts on the right angle socket facilitate termination to the PCB, minimising pin deformation. The SMT socket is available with locating pegs to ensure accurate alignment on the PCB prior to processing.

For further information circle 211 on the reader service coupon or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311. ❖

Silicon Valley NEWSLETTER



Internet appliances dominate Demo '96

At the recent Demo '96 conference in the Californian desert town of Palm Springs, a number of companies demonstrated new and prototype products for what looks set to become a vast new industry for 'Internet Appliances'. These are inexpensive computing devices that will enable everyday consumers to browse the World Wide Web for information, entertainment or electronic banking and shopping. Among the many offerings were:

- A device called 'WEBster' from Viewcall America in Norcross, Georgia, which uses a TV as a display and connects to a subscription Internet service.
- The 'TransPhone', from TransPhone in Ottawa, Ontario, which will be a combination telephone and Web browsing device.
- The 'Easy Rider' from Teknema, a network computer that integrates software and hardware designs with Teknema's Web browser and systems software. The US$500 Easy Rider is based on an ARM microprocessor. In its simplest form, the computer consists of a processing unit with 4MB of RAM, modem connection to the Internet, VGA display, keyboard and mouse. Teknema plans to have production-ready units for the second quarter of 1996.

Sun Microsystems also showed a stripped down personal computer called the 'NP Zero' Internet terminal, a network computer prototype that runs a Web browser with embedded Java software programs.

Oracle showed the 'NC' (Network Computer) Internet device it first demonstrated in Japan in December. The NC offers Internet access, E-mail access, and word processing.

There was plenty of optimism that the Internet appliance market may actually free the computer industry from the 'Wintel' stranglehold put on by the dominance of Microsoft and Intel. "Competition is back in our industry in a pretty good way", said David Coursey, editor of the *PC Letter* newsletter and the conference organiser for Demo.

Other products shown at Demo '96 included The Pilot from the Palm Computing division of US Robotics, a US$300 handheld computer weighing less than six ounces. Its two AAA batteries can last up to a year.

The Pilot contains a personal information management program — calendar, address book, etc. — that runs both on the Pilot and on a desktop PC. Users will have to learn the 'Graffiti' alphabet, however, a slightly altered set of the alphabet that the pen-recognition software understands. The organiser automatically synchronises its data with the desktop machine at the press of a button. US Robotics promised the product will be on the market by the end of March in a Windows version, with a Mac version in May.

Ex Machine announced AirMedia Live, a product that works in the background and pushes information many people may need over the public airwaves and onto the screen of your desktop computer. Using paging networks, AirMedia shoots news, finance, sports and a host of other information into a PC receiver that offers the updates in a window on the desktop PC screen.

Asia/Pacific to lead the world

In a trend that will cause a major shift in the electronics industry, the Asia/Pacific region is likely to become the world's leading producer of electronic devices by 2000 and will also start consuming vast quantities of its industrial output as Asia's middle-class population increases and becomes wealthier, according to Dataquest.

The middle classes in Hong Kong,

Silicon Valley semiconductor production equipment maker Lam Research has formed a strategic alliance with Taiwan's Ministry of Economic Affairs (MOEA), to allow Lam to become a key player in Taiwan's semiconductor industry development. Here Lam Chairman and CEO Roger Emerick signs the agreement with Dr Shih-Chien Yang, Senior Vice Minister of MOEA.

Singapore, the Philippines, China, South Korea and Taiwan are expected to rise a combined 8% by 2000, twice as fast as the rest of the world.

"Some of those people will start electronics companies. We are already seeing this in Taiwan", said Gene Norrett, vice president of Dataquest's semiconductor group. "And they will buy the goods they produce, as workers at electronics factories tend to buy lots of the electronics goods they make."

Norrett sees worldwide electronics production rising from US$750 billion last year to US$1.2 trillion by 2000, driven by new devices like personal videoconferencing systems, digital TV set-top boxes, and Internet appliances and mobile communications.

North American companies currently make 31% of the world's electronics goods, while Asia/Pacific companies make 20%. Norrett predicts that by 2000 North America will fall to about 28% and Asia/Pacific's share will rise to about 32%.

While personal computer shipments slowed in the United States in 1995, demand is rising sharply in Asia, particularly in the home education market.

Semiconductor demand will rise with hot sales of personal computers and mobile communications in Asia, Norrett said. The US$155 billion semiconductor market was slightly larger than the $125 billion personal computer market in 1995. Dataquest expects world wide semiconductor revenues to more than double to a US$331 billion market by 2000.

Quantum stops making high-end drives

Disk drive maker Quantum is planning to get out of the money-losing business of manufacturing its own high-end disk drives, a business that it spent hundreds of millions of dollars on getting into. As a result, some 2250 people will be laid off at plants in Milpitas and Malaysia.

Quantum said it will contract the production of the drives out to Japan's Matsushita-Kotobuki Electronics Industries, the same Matsushita subsidiary which already manufactures Quantum's low-end drives that represent the bulk of Quantum's sales.

The move will force Quantum to take a write off of between US$160 million and $190 million in the current quarter in connection with the shutdowns. When the plant closings are completed by fall, Quantum will have no manufacturing operations in the Bay Area for the first time since its founding in 1980.

The company spent heavily on the manufacturing facilities in recent years, in an attempt to diversify from its low-end product line. In 1994, for example, it paid US$360 million for the disk drive business lines of Digital Equipment.

Analysts said Quantum was never able to make the high end operations either profitable or integrated with the rest of the company.

Motorola may foil Apple-Sun merger

Although executives for Apple Computer and Sun Microsystems continue their discussion regarding a possible merger of what many are now jokingly referring to as 'Snapple', talks reportedly have stumbled on the issue of price.

Meanwhile Motorola is reportedly considering entering the battle for control of Apple, its main customer for PowerPC chips.

Motorola's move may well be inspired by fears that it could lose Apple as a customer for millions of its PowerPC processors. Some analysts have suggested Sun may want to port the Macintosh operating system over to its Sparc processor platform, in order to create a powerful computing platform that would stretch from US$500 Internet computers to corporate network servers.

Sun is reportedly offering US$33 a share or less for Apple, while Apple's board wants significantly more.

Hopes fade for new chip deal with Japan

The US Semiconductor Industry Association rates its chances for obtaining a new chip trade agreement between the United States and Japan as very slim. Negotiating a new deal is among the SIA's top goals for 1996.

The current chip pact expires in July and SIA officials fear that without some trade agreement, Japan will fall back on its system of keeping foreign competition out.

"It might have worked well if it were not expiring this year", said SIA president Thomas Armstrong, referring to 1996 which is a critical election year in both the US and Japan. "We'll see some political arm wrestling."

US chip makers are in good health now, Armstrong said, with 43% of the worldwide semiconductor market. The previous three chip trade deals have helped push the foreign chip market share in Japan to increase from less than 10% in 1986 to about 26% today. The success has prompted Japanese executives and government officials to argue that the trade agreement is no longer necessary.

Armstrong believes the agreement should be preserved because the natural Japanese business structure — consisting of interlocking corporations known as keiretsu — is alive and well, and is designed to lockout foreigners.

US Trade Representative Mickey Kantor turned the chip trade issue into a political football recently when he said the chip agreement had worked and therefore should be extended to include numerical targets in the auto market.

Japan's Prime Minister Hashimoto has already expressed his opposition to a new agreement.

Meanwhile, the US Congress and the White House are preoccupied with the budget battle. In such an environment, it is unlikely a new agreement will be reached.

H-P in $1.2B Taiwan fab venture

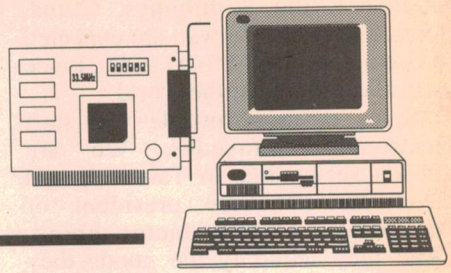
Joining the huge boom in semiconductor manufacturing in Taiwan, Hewlett-Packard reportedly plans to set up a large joint venture chip foundry that will produce up to 30,000 eight-inch wafers a month and is due to start operations by the end of 1997.

Other local and international chip makers have already announced plans for 20 new 8" chip fabs costing an average of US$800 million.

A major partner in the venture is WK Technology Fund, Taiwan's largest venture capital firm. Other partners reportedly include Rohm, Rockwell Semiconductor Systems, a Singapore's state-owned technology firm and another unnamed Taiwan company.

The four companies will invest some US$1.2 billion in the facility. HP, which will have the majority stake in the operation, plans to provide capital and to licence IC technology to the plant, to be located at the Linkou Hwa Ya Technology Park in a southern Taipei suburb. The plant will use 0.35-micron deep process technology in making the wafers. ❖

Computer News and New Products



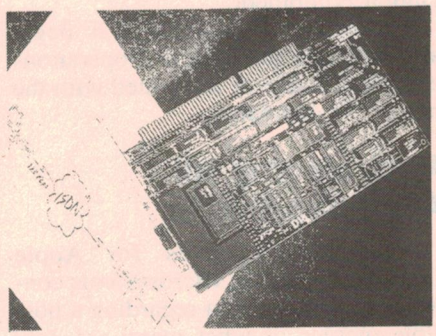
ISDN card for PCs

Sealcorp has announced the Australian released of the Digi PC IMAC ISDN card. The card is claimed to quadruple the speed of Internet access, and provide improved bandwidth on LAN/WAN connections. The integrated terminal adaptor/network interface card installs in any ISA PC and connects directly to an ISDN line.

When coupled with ISDN lines, the card features transmission rates of 128,000 b/s. Remote LANs can connect as if they were locally attached, while Internet sites can be accessed and downloaded at four times the speed of conventional modems.

ISDN connections are available in a quarter of a second through the card, compared to 30-90 seconds for a modem over the public switched telephone network. A word processing file, for example, can be completely downloaded in the same time it takes a modem to make a connection.

The ISDN cards are manufactured by Digi International in North America and are fully Austel approved for Australian use. Recommended retail prices start at $1952 excluding sales tax.



For further information circle 171 on the reader service coupon or contact Sealcorp, PO Box 670, Lane Cove 2066; phone (02) 418 9099.

Pentium SBC has PCI, SVGA

Priority Electronics has released the PCM-5860 all in one single board Pentium computer with an on-board PCI-SVGA controller, a PCI Ethernet interface and a PCI expansion slot. The PCM-5860 offers all the functions of an industrial computer on a single board, but fits in the space of a 5-1/4" floppy drive. The board also supports second level cache sized from 256KB to 512KB.

On-board features include two serial ports (RS-232 and RS-232/422/485), one multi-mode parallel (ECP/EPP/SPP) port, a floppy drive controller and a keyboard/PS/2 mouse interface. The built-in high speed PCI IDE controller supports both PIO and bus master modes. Up to two IDE devices can be connected, including large hard disks, CD-ROM drives, tape backup drives and other IDE devices.

The board also features power management to minimise power consumption. It complies with the 'Green Function' standard and supports three types of power saving features: doze mode, standby mode and suspend mode. In addition, the board's watchdog timer can automatically reset the system or generate an interrupt in case the system stops due to a program bug or EMI.

For further information circle 162 on the reader service coupon or con-

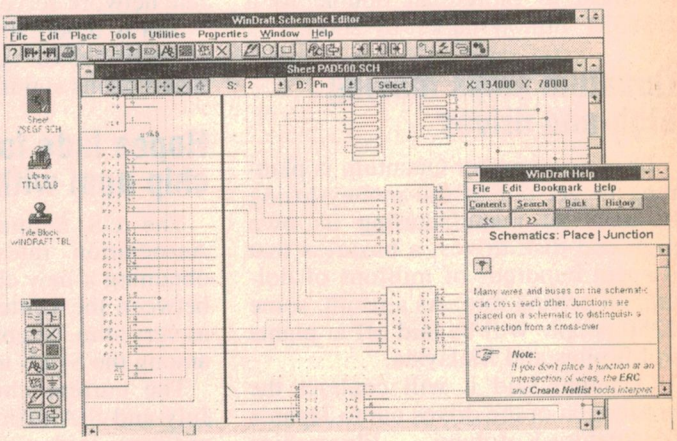
PCB design, schematic CAD software

WinDraft 1.2 from Ivex is a schematic drawing program that can copy and paste to and from the companion package WinDraft (PCB design package) as well as other Windows-based programs. WinDraft 1.2 can also store component attributes in the library parts so the user can build up libraries containing all information such as internal stock number, alternative part, SMD module name etc — so it doesn't have to be added each time the parts are used in a schematic. The new release also works with Windows 95.

WinDraft is a front-end for WinBoard PCB layout, a complete interactive manual router that began shipping in June 1994. WinBoard PCB layout program version 2.10 is now available and includes 17 enhancements. The program will now automatically remove floating copper from copper zones, improving the electrical quality of the manufactured board and its appearance.

Two items requested by current users doing RF designs have been added: an indicator for the total track length and the ability to start track or mounting hole placement at exact X-Y coordinates.

An evaluation version of both WinDraft and WinBoard can be obtained off the EA BBS, or World Wide Web at:



http://www.ivex.com, or wdshare.exe and wbshare.exe respectively on the anonymous FTP service. These are fully functional products with a 100 pin/pad limitation. Or you can purchase a set of disks, complete with 'Getting Started' booklet, from ME Technologies at a cost of $20 per program.

For further information circle 161 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429, phone (065) 50 2200.

tact Priority Electronics, 189 Bay Road, Sandringham 3191; phone (03) 9521 0266.

Solid state disk on a card

Priority Electronics has released the Flash solid state disk family. This includes the PCD-896 series, which consists of half size ISA bus plug-in cards, and the PCM-3820 series, PC/104 boards that conform to the PC/104 form factor. The cards use TSOP Flash memory chips that mount directly on the printed circuit board, and enable up to 32MB of disk emulation. Unlike their predecessors, the new Flash memory is capable of 100,000 write cycles (typically 1,000,000).

As the SSDs contain no mechanical components, they have an average seek time of less than 0.1ms (about 100 times faster than high performance HDDs). The SSD also reads 10 times faster than their mechanical counterparts. Since these cards do not require a battery for backup, they are much more reliable when power failures occur.

Each card features an on-board expansion BIOS that eliminates the need for additional software and also enables auto-boot. Industry standard True FFS (Flash File System) is used for disk emulation. It is fully compatible with standard operating system calls, down to file and sector level. At present True FFS supports MS-DOS, MS Windows, DR-DOS, QNX and VENIX.

For further information circle 166 on the reader service coupon or contact Priority Electronics, 189 Bay Road, Sandringham 3191; phone (03) 9521 0266.

Data acquisition for laptops

A new family of data acquisition modules from Decision Data Inc. has been designed for the 'plug and play' environment, making it ideal for in-the-field use. The Pocket-ADDIO family allows the field engineer to connect up to 16 modules to one notebook computer via its parallel port, thus eliminating any need for internal cards or PCMCIA connections.

The 16 modules can be any combination of 10bit A/D, 12bit A/D, 16 digital inputs, 16 digital outputs or eight digital inputs and eight digital outputs. The A/D modules can be supplied with either 0-5V or 0-10V channels. The digital I/O modules can be connected to a variety of interface modules with a selection of photo isolated inputs, relay outputs or SSR logic outputs.

Any notebook computer with a parallel port using the Pocket-ADDIO family of products can support up to 256 lines of digital I/O or A/D channels simultaneously, or any combination in groups of 16.

For further information circle 165 on the reader service coupon or contact Nucleus Computer Services, 9B Morton Avenue, Carnegie 3163; phone (03) 9569 1388.

Multiple output clock generator

Pericom Semiconductor's PI6C470 is a low cost clock generator designed to replace multiple oscillators on Intel's 486 and Pentium based motherboards.

Pin-compatible with the IMISC470 clock generator, the PI6C470 generates multiple clocks needed by the motherboard, including an MCLK signal and several peripheral clocks.

The MCLK has 11 options of 80, 66.6, 60, 50, 40, 33.3, 30 and 25MHz clock signals. The frequency selection of the MCLK output is determined by the S0-S2 pins and associated control pins. Two peripheral clocks with fixed frequency of 24 and 16MHz are also provided, along with a REF14 output which generates a buffered reference frequency of 14.318MHz. The clock generator integrates two clock buffers to generate two banks of one clock output and four low skew clock outputs.

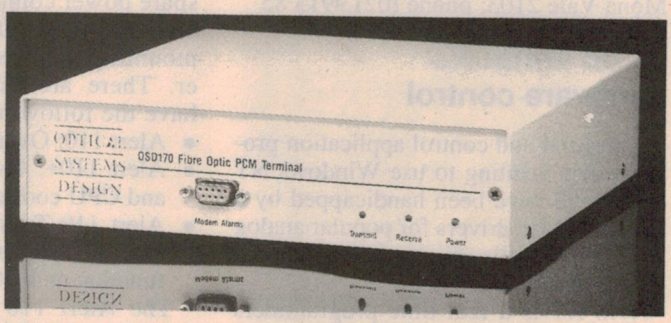
Features include power down mode for low power consumption, smooth and glitch free frequency transition from one CPU clock to another, and low short and long term jitter.

For further information circle 204 on the reader service coupon or contact Reptechnic, 3/37 Bydown Street, Neutral Bay 2089; phone (02) 9953 9844.

Optical PCM modem

The OSD170 from Optical System Design is a low cost, high performance PCM terminal designed primarily for in-house links such as PABX interconnects, 2.048Mb/s data switch links and the like.

It operates essentially as an analog link, optimised for the transmission of balanced ternary signals with peak amplitudes of 2.37V, that will transmit any standard G.703 signal from T1 (1.544Mb/s) to E2 (8.448Mb/s) without the need for



any user adjustments. In its basic form no regeneration function is included as in most applications regeneration will normally be provided by the customer's equipment. Operation at either 850nm or 1300nm is available; in either case sufficient power is coupled into standard 10/125um single mode fibre to allow useful distances to be spanned, as much as 30km at 2.04Mb/s when operating at 1300nm.

The unit is available in a self contained case which takes up half a modem tray in a standard 19" rack.

For further information circle 170 on the reader service coupon or contact Optical Systems Design, PO Box 891, Mona Vale 2103; phone (02) 9913 85

32 bit Windows hardware control

Industrial and control application programmers wanting to use Windows NT or Win 95 have been handicapped by a lack of device drivers for popular analog to digital boards, digital I/O cards and counter/timer hardware.

Win RT is a real time programmers tool kit for Win32 hardware control. Available from Instrument Engineering, the package ships with a library of sample code and six months' technical support. The software package provides access to hardware controls at user level without having to create device drivers from scratch with the Device Drive Kit (DDK).

Windows NT and Win 95 developers using C or C++ languages can directly access port I/O, memory I/O and interrupt handling, and distribute the royalty-free runtime kernel mode driver with their application. Visual Basic 4.0 programmers can use a 32 bit OCX for the same flexibility. Many customers report saving weeks of DDK work.

For further information circle 163 on the reader service coupon or contact Instrument Engineering, PO Box 168, West Ryde 2114; phone (02) 874 2457.

Overheating alarm

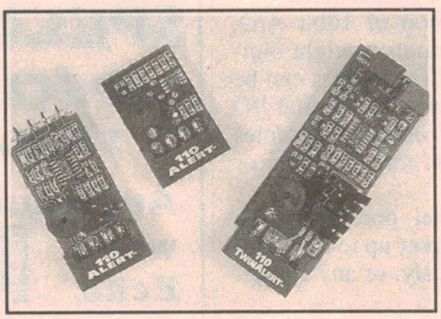
The Alert 110 is an over-temperature alarm that warns of inadequate cooling before damage occurs to the computer. It sets off an alarm when the internal temperature reaches 43°C (110°F), allowing the user to shut down the system before major damage occurs.

The device is very simple to install and only requires plugging into a spare power connector, peeling off the back of the double sided tape and mounting near the top of the computer. There are three versions, which have the following features:

- Alert 110: Over-temperature alarm
- Alert 110+: Over-temperature alarm and CPU cooling fan failure alarm
- Alert 110 TwinAlert: Over-temperature at 43°C and system shutdown function at 48°C.

The Alert 110 is priced at $32.50, the Alert 110+ at $52.50, and the Alert 110 TwinAlert at $52.50, including tax in each case.

For further information circle 168 on the reader service coupon or contact Hypec Technology Group, 34 Herbert Street, West Ryde 2114; phone (02) 808 3666.



PCMCIA data acquisition card

Intelligent Instrumentation has announced I/Ocard, a new portable data acquisition system for the PCMCIA bus. Designed for notebook PCs, the system requires only one watt of power, making it ideal for remote applications. I/Ocard connects to a PCMCIA type II slot and consists of a PC card and a termination pad.

The card features eight differential analog inputs at 12-bit resolution, 30kHz throughput and external triggering. Gains and input ranges are software selectable; both unipolar and bipolar input ranges are available.

Model PCI-460P-1 provides gains of 1, 10, 100 and 1000 for extremely low level signal measurement, and PCI-460P-2 provides gains of 1, 2, 4, and 8. The system also features four digital inputs and four digital outputs at TTL-compatible levels, cold junction compensation for direct thermocouple connections, and voltage reference output for powering sensors which require excitation.

I/Ocard is supported by Visual Designer (PCI-20902S), Intelligent Instrumentation's Windows based application generator software. Users develop their own applications by drawing block diagrams (flowgrams) of the application.

For further information circle 167 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone 1800 335 245. ❖

CEIBO SYSTEM

Continued from page 119

incremented an 8-bit binary word on the output port. It would seem that, again, a fair degree of familiarity with microcontroller systems would be of great advantage.

This is not to say, however, that the hardware or software is at fault. Rather, that the manual could perhaps have been beta-tested before release, as it appears that vital information has either been left out, or incorrectly stated. This is a shame, as the system as a whole would appear to be excellent, with all the features you could ask for at the ridiculously low price of $159.

Considering the price, the DS-750 is certainly a very capable package, and with the money you would save over an equivalent system, you could easily afford a decent book on microcontroller programming.

My recommendation is to go out and buy the package, and to work through the tutorials given. This alone will give you an enormous insight into microcontroller operation and application design, and would be all you would need to break into this fascinating subject.

The DS-750 Development Tools package is available from Geoff Wood Electronics, 229 Burns Bay Rd., Lane Cove West, NSW 2066; Phone (02) 428 4111 or Fax (02) 428 5198. ❖

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